THE CONVERGENCE OF WELFARE ESTIMATES EMPLOYING TRAVEL COST AND CONTINGENT VALUATION METHODS: EVIDENCE FROM NEW YORK STATE ANGLERS

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Xiaoyang He

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ABSTRACT

Environmental goods are generally not exchangeable in the market, and, even when they are, the market price does not fully reflect recreation value. As a result, recreational fishing values are generally estimated using non-market valuation methods, which can be categorized into two different approaches: stated preference and revealed preference approaches. Numerous studies employ either the travel cost method (TCM), which is the most popular approach of revealed preference method, or the contingent valuation method (CVM), a representative of state preference approach, or both methods. However, none of these studies have compared open-ended CVM with a TCM employing a random utility model (RUM). The 1988 New York State Angler Survey includes half of the survey containing open-ended CVM questions and angler visitation data, which makes the estimates using both methods and the comparison available. A nested logit TCM is applied in this study and gives an estimate of recreational fishing value ranges from \$23.11 to \$25.37 per day. The mean willingness to pay (WTP) estimated under open-ended CVM is \$24.96, showing statistically convergence to the estimate derived from TCM, which in return, providing the evidence of convergent validity for both methods.

BIOGRAPHICAL SKETCH

I grow up in Daqing, a city lies in the Northeast of China, whose all economy depend on the production of crude oil resource. My father is an engineer on crude oil exploration and I gradually realize the importance of sustainable utilization of natural resources as the civilization and development limitation appears in my hometown. I began my undergraduate study and majored on Economics in Nankai University, where I first got to know about Environmental and Resource Economics, and then decided to further develop my interest on this area in Dyson School of Applied Economics and Management at Cornell. I took the Environmental and Resource Economic course in my first year graduate study, and after that, I participated in the project "Exploring the Shelf Life of Travel Cost Methods of Valuing Recreation for Benefits Transfer". This research project is fascinating to me since it concerns with the environmental recreational resources protection and the methodology it employed is broadly applicable to many developed and developing areas. In the future, I plan to continue research in Environmental and Development Economics.

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CHAPTER 1

INTRODUCTION

Environmental goods have significant “collective good” characteristics since individuals generally cannot be excluded from enjoying environmental improvement nor can they avoid environmental degradation. These goods are generally not exchangeable in the market and even if they are, the market price does not fully reflect their true value. However, to design efficient policies from an economic perspective, we need to know the marginal price of the environmental goods so as to find the optimal quantity or quality of an environmental good where the marginal cost of supplying the goods is equal to its marginal benefit. Environment valuation is an extension of existing benefit-cost techniques to value natural environment over the last 50 years. Two main approaches have been developed to elicit people’s willingness to pay for environmental goods: stated preference methods and revealed preference methods. In the non-market valuation literature, these methods are also classified as direct and indirect methods respectively.

One of the most widely used stated preference methods is the Contingent Valuation Method (CVM), which involves asking individuals in surveys to reveal their personal evaluation of a hypothetical environmental change. This method has passed the experimental prototype stage, and has reached the routine application stage after more than 30 years of research. Nevertheless, concerns remain about the validity of CVM primarily because of its hypothetical nature. Though CVM seems very easy to use, it is vulnerable to misuse. But if it is properly designed, CVM offers a unique possibility for finding the total value, including both use and non-use values. In addition, it can be used to make ex-ante analysis and analysis under certain constraints.

The Travel Cost Method (TCM), serving as one of the revealed preference methods, can calculate the current use value of a recreational area based on observed behavior in the market. Estimating non-use value under this method is not possible, since all calculations are based on people's true market behavior, which to some extent avoids bias introduced during hypothetical processes. Because this method is based on actual choice, it has been better received than stated preference methods by the economics community.

Environmental valuation studies employing these two methods are prevalent in the economics literature. Comparison between these methods has also frequently appeared in some articles when estimates using both methods were available. However, none research on valuing recreational fishing activities in New York State have conducted such comparisons.

This study attempts to explore the consistency of the estimates of fishing day values obtained from two prevailing used non-market valuation methods, CVM and TCM separately. The data used in both methods are drawn primarily from the 1988 New York State Angler Survey. Two versions of questionnaire were designed and each administered to half a systematically selected sample. Both versions contained the same core set of questions on fishing effort and expenditures by fishing location, angler attitudes and preferences for fishing programs, and socio-demographic characteristics. Only one version contains CVM questions including people's maximum willingness to pay for specified trip, reported cost and spent days of that trip.

This study uses both CVM and TCM to estimate the value of recreational fishing in 1988 in New York State. For the travel cost approach, a repeated nested logit travel cost model is computed using MATLAB programming software to give an estimate of the daily value of recreational fishing. After multiplying this daily value by the estimated total angler days in year 1988, an estimate of the yearly value of recreational fishing can be obtained. The travel cost estimate ranges from$23.11 to $25.37 per day resulting in a yearly value between $479.91 and $526.78 million. The estimated value of recreational fishing per day using CVM is $24.96, which results in a yearly value of $518.34 million. Convergence between the values obtained from these two methods is obvious, with the contingent valuation estimates not significantly different from the value estimated by the travel cost approach.

Chapter 2 of this thesis provides a summary of the 1988 New York Statewide Angler Survey including the estimated angler days in 1988, which will be further used in calculating yearly fishing values. Chapter 3 summarizes the contingent valuation method including its elicitation techniques, welfare estimate, validity and reliability and latent bias. Chapter 4 introduces methods of estimating the travel cost model, mainly the standard logit and nested logit models that are employed in this study. Chapter 5 introduces some relevant literatures on comparisons between these two methods. Chapter 6 introduces the methodology of this study and Chapter 7 lists the main results. Chapter 8 is the conclusion of the thesis. Limitations and further research are stated in Chapter 9.

CHAPTER 2

THE 1988 NEW YORK STATEWIDE ANGLER SURVEY

In 1988 the New York Department of Environmental Conservation (DEC) funded a statewide angler survey designed in part to estimate values of the recreational fisheries of the state. The survey had multiple objectives including: obtaining current estimates and trends of effort and expenditures of anglers that can be related to specific waterways and to interest in particular species; determining the degree of angler awareness of, and adherence to, health advisories related to the eating of fish; determining boating patterns related to fishing, including an evaluation of improvements needed in DEC boat launch facilities in various regions of the state; obtaining a sufficient data base on economic values associated with particular fisheries to allow estimates of those values; and obtaining other angler attitude and preference information related to various New York fishing programs.

2.1 Methods

A systematic sample of 17,000 licenses was selected for the license year beginning October 1, 1987 and ending September 30, 1988. All licenses that permitted either resident or nonresident fishing formed the population from which the sample was drawn. The licenses were selected at three times during the course of the year to facilitate data entry of names and addresses. Because of the large amount of information sought from this survey, two questionnaires were developed and administered to systematically selected halves of the sample. Each contained the same core set of questions on fishing effort and expenditures by fishing location, angler attitudes and preferences for fishing programs, and socio-demographic characteristics. The remainder of the two instruments contained different questions for which such a large sample was not needed. Topics covered by these questions included angler satisfaction, angler awareness of health advisories, boat ownership and boat characteristics, capital expenses, and willingness to pay. A mail survey was implemented by the Cornell Institute for Social and Economic Research (CISER) in January 1989. Up to three follow-up mailings were sent to nonrespondents over the course of the following month. The two different questionnaires are shown in detail in Appendix 1.

2.2 Sample Representation and Response Rate

Post-selection analysis showed that a slightly higher percentage of resident fishing license buyers and a slightly lower percentage of sportsman license buyers and nonresident license buyers were selected for the sample than existed in the fisher population. However, analysis of respondents to the survey showed no significant change in the number of days fished if respondents were weighted by license type. So the sample selected does not lose its representativeness of the underlying population.

Among the 16,998 questionnaires mailed, 468 were undeliverable and 10,314 completed questionnaires were collected in the end, which resulted in an adjusted response rate of 62.4%. A follow-up analysis showed that nonrespondents were less likely to have fished and those who fished tend to fish fewer days than respondents.

2.3 Estimation of Angler Days

Based on survey responses, an estimated 85% or 1,013,000 of the 1,192,214 fishing license holders fished at least one day in 1988. Respondents reported fishing a total of

20,767,000 days in 1988, or a mean of 20.5 days per angler. Table 1 shows that 84% percent of anglers fished inland waters for a total of 16.1 million days. Forty-two percent of anglers fished some section of New York's Great Lakes waters[1] for a total of 5.3 million days.

Fishery management in New York is divided into nine regions, which is shown in Figure 1. This provides convenience to manager with insight into levels of fishing activity associated with each region. Table 2 provides regional estimates of the number of anglers and angler days by DEC regions of residence and nonresidents based on the 1988 survey data.

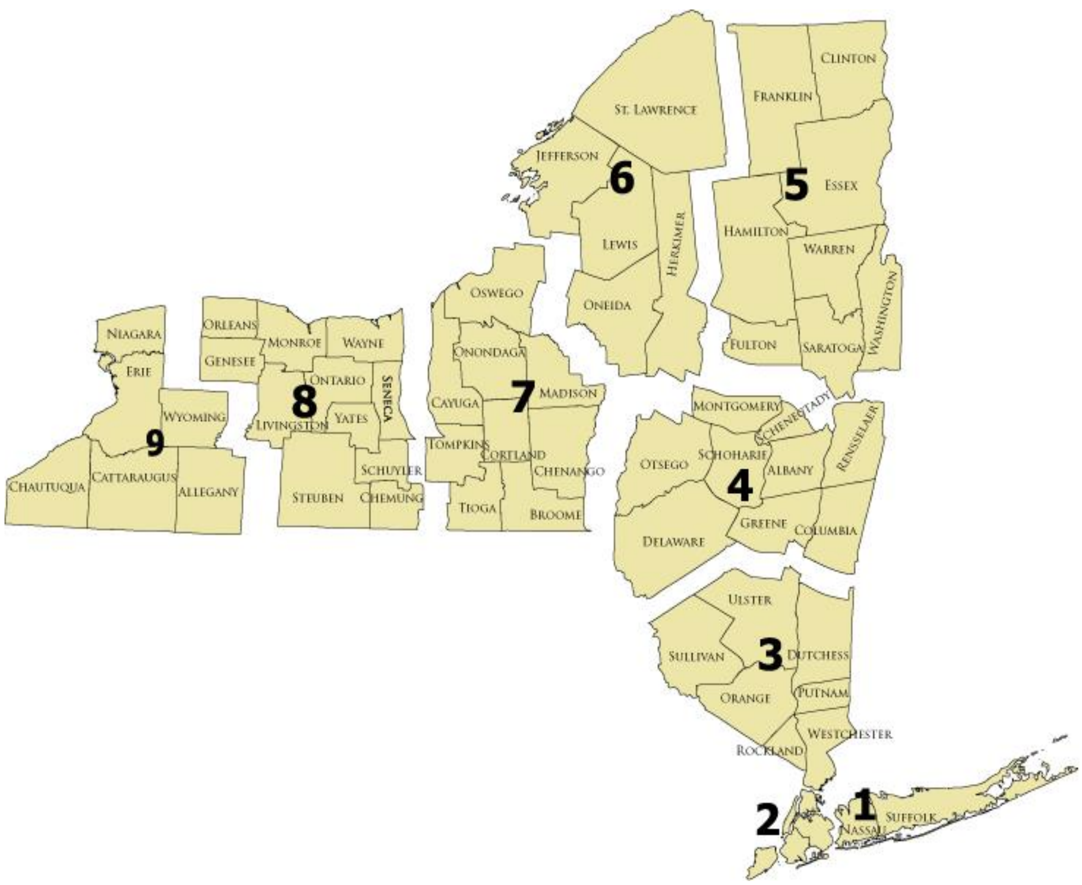

Figure 1: DEC Regions in New York State (Source: DEC Official Sites)

[1] Great Lakes waters are defined as the New York portion of Lake Erie, the Niagara River, Lake Ontario and its embayment, and the portions of tributaries in coastal counties.

Table 1: Estimated number of anglers and angler days for Great Lakes and Inland Waters

	ANGLERS			ANGLER DAYS	
	Percent[1]	Number	Confidence Limits(+/-)	Number	Confidence Limits(+/-)
Great Lakes	42.5	430,690	9,930	5,303,340	308,250
Inland Waters	84.0	851,240	7,940	16,070,050	557,210

Source: Connelly and Brown (1990)

Table 2: Estimated number of angler and angler days for DEC residence and non-residence

	ANGLERS		ANGLER DAYS	
Region of Residence	Number	Confidence Limits	Number	Confidence Limits
1&2	50,670	4,640	850,720	122,300
3	100,320	6,350	2,130,180	181,090
4	85,120	5,900	1,851,670	170,600
5	76,000	5,600	1,888,040	188,770
6	81,070	5,770	1,827,930	178,030
7	153,020	7,620	3,421,650	251,260
8	149,980	7,560	3,439,180	227,970
9	144,910	7,450	3,632,080	250,490
Out of State	172,270	7,990	1,799,290	129,050

Source: Connelly and Brown (1990)

Table 3: Estimated number of anglers and angler days by DEC region fished

	ANGLERS		ANGLER DAYS	
Region Fished	Number	Confidence Limits	Number	Confidence Limits
1&2	21,940	3,440	334,640	70,990
3	142,950	7,940	2,419,600	207,940
4	120,440	7,160	1,570,330	159,030
5	228,040	9,310	3,267,290	241,180
6	238,420	9,530	2,922,550	210,030
7	274,110	9,930	3,893,210	284,780
8	220,510	9,310	3,468,890	247,830
9	191,180	8,880	3,844,720	247,410

[1] Percentages across Great Lakes and Inland Waters sum to greater than 100 percent because individual anglers may fish in both locations during a season.

CHAPTER 3

CONTINGENT VALUATION METHOD

The contingent valuation method (CVM) is one of a number of ways that economists have developed to value public goods. It is a stated preference approach that uses survey questions to elicit people's preferences for non-market goods by finding out their maximum willingness to pay (WTP) for a specified change in the provision of the public good: WTP is the largest amount that a respondent would be willing to exchange to achieve the increase in environmental quality or the decrease in ecological pollution. To elicit people's WTP in dollar amounts, respondents are presented with a hypothetical market in which they indicate their payment amount for certain goods in question. After collecting valid WTP responses, researchers can use the amounts to develop a benefit estimate for the policy change.

This method was first proposed by Ciriacy-Wantrup (1947), who held the opinion that the prevention of soil erosion generates some "extra-market" value and that one possible way of estimating these values is to elicit individual's WTP through a survey method (Portney, 1994; Hanemann, 1994). The first empirical application of CVM was by Davis (1963) who estimated the benefits of goose hunting through a survey of goose-hunters (Portney, 1994; Hanemann, 1994). The CVM gained popularity after that, especially when two major non-use values, namely, option and existence values, were recognized as important components of the total economic values in environmental economics literature in the 1960s Weisbrod (1964) initially introduced the concept of option value, which means the value of preserving threatened natural resources so that they might be available for use in the future. And Krutilla (1967) first introduced the concept of existence value, though he used the term "sentimental value", to mean the WTP for the existence of an environmental resource without any present or future on-site use. Since conventional revealed preference methods, such as TCM, are not capable of capturing these non-use values (Smith, 1993), the only ways that can be identified for estimating theses values are the stated preference approaches, such as the CVM (Desvousges et al., 1993). This is important because a comparison of estimated non-use values associated with the oil spill (Carson et al., 2003) using the contingent valuation method and recreational use values estimated using revealed preference methods (Hausman et al., 1995) suggesting that non-use values can be a large component of total economic value.

3.1 Benefits and Measurements

Obtaining an accurate estimate of the benefits of a change in the level of provision of some public goods that can then be used in benefit-cost analysis is the ultimate goal of conducting a CVM study. Conceptually, net benefit is defined as the area under the ordinary Hicksian demand curve and above the price line. However, which Hicksian consumer surplus measure --WTP or willingness to accept (WTA) --should be used for measuring a given welfare change should be chosen very deliberately.

Considerable empirical evidence has shown that there is a divergence between WTA and WTP. Two different categories have been proposed to explain why WTA is greater than WTP. The "psychological" argument was first put forward by Kahneman and Tversky (1979), positing that there is loss aversion in general, which means when a good becomes part of your endowment, the value you place on it increases. This is also referred as the "endowment effect". An alternative "neoclassical" explanation for WTA exceeding WTP comes from Hanemann

(1991), who gives an example of Yosemite National Park, demonstrating that if there is no market substitute for the unique good, then it is not possible to compensate for its removal. Thus WTA is infinite while WTP is finite since it is bounded by income. Alternatively, if there is a low cost market good that is a perfect substitute, WTA should theoretically equal WTP. This is so called the "substitution effect". Shogren et al. (1994) present experimental results testing these two theories and claim to refute the endowment effect while supporting the substitution effect. Hanemann (1991) also notes that an income effect, to some extent, may also contribute to the divergence between WTP and WTA.

Some other arguments, rather than focusing on explaining why true WTA is greater true WTP, emphasize the difference between "announced" WTP and WTA. One explanation pertains to repeated trials or auctions of the same item, stating that once a transaction is consummated the information value[1] drops to zero, which provides an incentive for people to understate WTP or overstate WTA. Kolstad and Guzman (1998) develop a model of auction equilibrium where bidders do not know their true valuation but can expend effort of money to learn that valuation, showing that divergence emerges between WTA and WTP. If the cost of information acquisition is greater, the divergence increases. Other factors, like "weak" experimental features such as hypothetical payments, student subjects, or elicitation questions that are not incentive compatible are also cited to explain the divergence. Horowitz and McConnell (2002) find that the less the good is like an "ordinary market good", the higher the ratio of WTA to WTP, and the ratio is highest for non-market goods. They further find that WTA/WTP ratios in real experiments are not significantly different from hypothetical experiments and that the incentive-compatible

[1] Information value is generated from observing outcomes of future repetitions, since each repetition of auction provides information on the uncertain common value.

elicitation yields higher ratios. In a second study, they tested whether the observed pairs of WTA and WTP are consistent with neoclassical preferences and the income effect identified by Hanemann (1991). They used Sugden's (1999) result, which show that the effect of income on WTP can be approximated from information on the ratio WTA/WTP, to demonstrate that the level of divergence is not consistent with neoclassical preferences.

In practice, CVM researchers have shown that there is great difficulty in obtaining correct estimates of WTA for decreases in the level of a public good. This is largely because respondents tend to reject the implied property right as implausible (Mitchell and Carson, 1989). Hence later studies have mainly focused on WTP.

Conceptually, WTP reflects total economic value. Some texts divide total economic value into two classes: use value and nonuse value, where nonuse value includes existence value and option value (e.g. Harris and Roach, 2013). Other economists however, decompose the total economic value conferred by resources into three main components: use value, option value and nonuse value (e.g. Tietenberg and Lewis 2012). In this framework, use value consists of all the current direct and indirect ways in which an agent expects to make physical use of a public good. Nonuse values involve the notion that a person doesn't have to visit or plan to visit a recreational site to gain utility from its maintenance or improvement (Krutilla and Fisher, 1975). As discussed previously, option value reflects the value that people place on insuring that there are opportunities to use the environment in the future. Since the use value reflects the value derived from current use, not future use, and the nonuse value pertains to resources that people will never use, it is reasonable to separate option value as a third type of value. Even though CVM surveys are capable of measuring benefits that include a nonuse dimension, it seems to be less capable of obtaining meaningful estimates of each component values separately. This statement is based on the consumer behavior observation that people tend to arrive at a global judgment on the conditions described in the scenario instead of valuing each of the relevant benefits categories and subcategories and combine them to arrive at a total economic value. (Mitchell and Carson, 1989)

The question “Is the contingent valuation method capable of providing estimates of lost nonuse values that are reliable enough to be used in natural resource damage assessment?” was put in front of researchers following the Oil Pollution Act of 1990, when including lost passive use value as a compensable damage was passed by Congress just after the Exxon Valdez spill. While they conceded that hypothetical markets tend to overstate WTP for private as well as public goods, the so-called NOAA Blue Ribbon panel concludes that CVM studies can produce estimates reliable enough to be the starting point of a judicial process of damage assessment including lost passive-use values (NOAA panel 1993). In addition, NOAA also reviewed CVM in the context of assessing damages to natural resources in support of litigation and provided its guidelines for best practice.

3.2 Elicitation Techniques

As the mostly commonly used stated preference method, CVM usually involves asking questions directly about what value they place on a specified change in an environmental amenity or the maximum amount they would be willing to pay to have it occur. Mitchell and Carson (1989) listed four elicitation techniques, including Bidding Game, Payment Card, Open-ended, and Dichotomous Choice methods. According to Freeman (2003), the two types of contingent valuation questions that have most frequently been used are the Open-Ended CVM Questions and Discrete Choice CVM Questions.

3.2.1 Open-Ended Questions

Under open-ended questions (or continuous response questions), each respondent is typically asked to state their maximum WTP either for an environmental improvement (or compensating surplus, CS) or to avoid a loss (equivalent surplus, ES). There are many ways to elicit this number. One early type of open-ended question uses an iterative technique, which was called the bidding game. In a bidding game, individuals are first asked whether they would be willing to pay at certain amount (i.e. $X), and, if the answer is "yes", the question is repeated with higher price (i.e. $X+$Y) until the individual answers "no". The highest price with a "yes" response is interpreted as the maximum WTP. If the initial response to the original question is "no", the iteration proceeds downward (i.e. $X-$Y) until a "yes" response is received. However, a problem called "starting point bias" was detected when it was shown that different starting points for the bidding game result in different WTP outcomes. Boyle and Bishop (1985) find that starting point bias existed in three contingent valuation applications of bidding game method. As a result, this method is generally no longer used.

An alternative type of open-ended elicitation technique is simply asking open-ended questions, like how much would you be willing to pay for a specified change in a good or service. Different from the bidding game, the major problem with this approach is that it confronts people with an unfamiliar problem, since in real market settings they are usually faced with choice among sets of goods with listed prices. So, people have difficulties when dealing with the open-ended questions, which directly result in a low rate of response or high proportions of implausible stated values, i.e. zero values. (Halstead et al., 1992)

Open-ended questions are also highly susceptible to strategic responses. There are two forms of strategic bias including free riding and over-pledging (Mitchell and Carson 1989). When people expect that others would pay enough for the good, then the individual himself would understate his willingness to pay (i.e. free riding). Alternatively, if an individual assumes that his stated WTP value would influence the provision of good under hypothetical markets, over-pledging will happen correspondingly. Actually, according to Mitchell and Carson (1989) many reasons[1] make people's strategic behavior very weak for most of the CVM respondents. Based on that, researchers could avoid respondents behave strategically to a large extent by not providing any 'hint' when designing a CVM questionnaires.

Another variation of the open-ended approach came up by showing respondents a card with a range of alternative payment values on it and asking people pick up a value or state their own value if that is not on provided cards. This is called the payment card method, which Carson and Groves (2011) suggest is undergoing resurgence in use. Some concerns have been raised about censoring and truncation effects with payment card elicitation format. Rowe et al. (1996) conducted a study and found that the changes in the ranges covered by the payment cards did not affect the distribution of expressed maximum WTP as long as payment card did not truncate the upper range of values. Like the other open-ended studies, a further concern is incentive compatibility and strategic behavior.'

[1] Reasons include: The amount of information required for strategic behavior are great; respondents get the impression from the survey that the number of people participate are large so their stated WTP would not influence the overall outcome; payment vehicles used in CV studies remind the respondents about the budget constraint so that they respondents could not overstate their true WTP; the understatement of true WTP might be discouraged given the respondents' impression that the good under investigation may not be provided.

3.2.2 Discrete Choice Questions

According to Haab and McConnell (2002), a best practice for contingent valuation is to describe the market as a referendum in which the respondents are asked whether they would vote for or against the project in a public vote. Since the answer to a question of this type provides only an upper or lower bound on a respondent's value, statistical methods are used to translate this information into an estimate of distribution of economic value in the population. A careful experimental design and large sample size are necessary to get an efficient estimation of mean WTP.

In the simplest format, the discrete choice question asks each respondent whether they would be willing to pay a specified amount of money to obtain the environmental change in question. If the answer is "yes", the individual has indicated a WTP that is greater than or equal to the specified sum. If instead the response is "no", then that sum of money is taken as an upper bound on the true WTP. In this procedure, respondents should be assigned randomly to different subsamples to test that proportion of yes responses decreases with an increase in price. These data can then be analyzed with a model of discrete choice to obtain estimates of indirect utility functions or bid functions.

To address the concern that discrete choice question tend to make relatively inefficient use of a sample, a double-bounded format was introduced by asking respondents a follow up discrete choice question at a higher amount if the initial answer is "yes" and on a lower amount if the initial answer is "no". However, problems still exist in this approach. Researchers find that responses to double-bounded dichotomous choice questions by the same respondent are often inconsistent with each other (Carson and Groves, 2007). Additionally, downward bias, resulting from the excess no/no response to double-bounded dichotomous choice questions is supported by empirical evidence.

Advantages are enjoyed by the discrete choice format relative to the bidding game and other WTP formats. First, it places people in a relatively familiar social context. Second, since only a “yes” or “no” answer is required, it poses a relative simple decision for individuals. Third, provide that the overall survey is “consequential” the discrete choice format is incentive compatible (Carson and Groves, 2007), meaning that subjects will answer the CVM’s hypothetical question in the same way as they would answer an identical question asking for a real economic commitment and that, therefore, the hypothetical discrete choice method will result in accurate estimates of true willingness to pay (Cummings et al., 1995).

3.3 Welfare Analysis

A continuous valuation question produces a set of welfares measures, denoted by

$$W_i, \qquad i = 1,2, \dots, n \tag{3.3.1}$$

where, i is one of the n respondents in the sample, and W_i is either a CS or a ES measure, depending on the format of the question. An estimate of the total value of the welfare change for the population from which the sample is drawn can be obtained by calculating the sample mean

$$\overline{W} = \frac{1}{n}\left(\sum_{i=1}^{n} W_i\right) \tag{3.3.2}$$

and then multiplying by the total population.

$$W^* = N * \overline{W} \tag{3.3.3}$$

where N= size of population. Alternatively, the responses can be regressed on income and other socio-economic characteristics to obtain a bid function for a given change in quality q,

$$B_i^* = B^*(M, S_i) \tag{3.3.4}$$

In the above equation, S is a vector of socioeconomic characteristics that affect individual valuations. Then data on the characteristics of the relevant population can be used to calculate $\widehat{B^*}$for every member of the population. An alternative approach include variation in the size of the change in q across the sample as part of the survey design. As such the bid function becomes

$$\widehat{B_i^*} = B^*(\Delta q_i, M, S_i) \tag{3.3.5}$$

In open-ended questions, mean values are sensitive to the presence of large individual bids. Some bids are so large relative to the sample mean as to be obviously invalid for valuation purpose. Several procedures for identifying outliers have been used in the literature. The simplest procedure is to adopt a rule of thumb concerning the relationship between the stated bid and the respondent's income (Freeman, 2003). An alternative, like the one advocated by Mitchell and Carson (1989), is to calculate the α trimmed mean, where the analyst chooses the value of α. In addition, researchers can also use a set of regression diagnostic procedures to delete observations with unduly large influences on regression coefficients (i.e. Belsley et al., 1980).

In addition to invalid large responses, an open-ended sample could contain invalid zero responses, so-called "protest zeros". Protest zeros occur when respondents reject some aspect of the constructed market scenario by reporting a zero value even though they place a positive value on the amenity or resource being valued. One approach to solve this problem is to ask every respondent who gives a zero value to indicate a reason for doing so. Typically three categories of reasons will be listed as: I can't afford to pay anything, the good is not important to me or I don't think they should have to pay for the good. Respondents choosing the third statement would be classified as protest zeros and deleted from the sample, while the first and second would be considered valid zero responses. (Freeman, 2003)

For derivations of $\widehat{B_i^*}$ and $\overline{W}$ for discrete choice responses, the reader can refer to Hanemann (1984) or Cameron (1988).

3.4 Validity and Reliability

Surveys are used in a broad scope of economic research and three characteristics of CVM distinguish from most of the other conventional use of surveys. They are: (1) the novelty of the situation most CVM surveys pose to the respondent; (2) the need in CVM surveys to construct a market in which the good can be bought; and (3) the effort required for a respondent in CV surveys to arrive at a meaningful answer to many WTP questions (Mitchel and Carson, 1989). In comparison to traditional surveys, CVM surveys tend to provide more detailed questions and require greater effort from the respondents. In this sphere, CVM has shown great improvement over traditional survey methods.

The reliability and validity of the WTP responses are usually considered in the evaluation of the CVM. Reliability usually refers to the extent to which the variance of a response or estimate is a result of random resources or "noise". The validity of a measure is the degree to which it measures the theoretical construct under investigation, for example, what respondents would actually pay for a public good in a market for it exist (Mitchell and Carson, 1989). There are three types of validity usually discussed in the CVM literature: content validity, criterion validity and construct validity. Further the construct validity can be divided into convergent validity and theoretical validity.

3.4.1 Criterion Validity

Criterion validity is concerned with whether the measure of the construct is related to other measures, which may be regarded as criteria (Mitchell and Carson, 1989). Tests for criterion validity compare the prediction from a stated preference exercise to a standard that approximates to a true measurement involving real payment. The specific question for this kind of validity is "Is the estimate generated by stated preference methods the same as a willingness-to-pay value that would be generated if real payment was made?"

Experimental methods in the laboratory and field have mainly been used to assess the criterion validity, with two types of laboratory experiments being applied to gauge criterion validity. One type is the induced-value experiment[1], which has primarily been used to examine the accuracy of hypothetical referendum-style elicitation vehicles relative to binding real payment votes. The results generally show that the distribution of values from hypothetical votes matches the induced-value criterion in the aggregate. The other type of experiment is homegrown value experiments[2] in which the criterion is established by a real payment mechanism. A consistent finding for this type of experiment is that stated values are higher than their real counterparts, which is known as hypothetical bias. Though many meta-analyses and field experiments (List and Gallet, 2001; Murphy et al. 2005; Harrison and Rutstrom, 2008) have

[1] In induced value experiments, participants are assigned a value for the experimental good and hence the researcher knows with certainty the criterion against which real and hypothetical statements of value are compared. That is the value is assigned to the respondent as opposed to it having arisen internally from the respondent's own preference.
[2] Different from the induced value experiment, in homegrown value experiments participants' actual payments for a real commodity are used as the criterion and participants' own (or hometown) preferences are the basis for establishing the standard for comparison.

shown a consistent upward bias in the hypothetical values when examining CVM criterion validity, the set of findings is hard to interpret as criterion invalidity since not all of the studies satisfy the incentive-compatibility and consequentiality requirements identified by Carson and Groves (2007). Indeed, Poe and Vossler (2011) suggest that criterion validity tests that were conducted without adherence to the consequentiality requirements should not be considered when assessing the potential for hypothetical bias. In their review, four induced value experiments and one home-grown value experiment that are consistent with Carson and Groves (2007) requirements were identified. These experiments collectively demonstrate that if survey respondents perceive their decisions to be consequential, then this motivates responses that are quite different from those in inconsequential settings. Notably, when consequentiality is imposed and incentive compatibility mechanism are employed, then CVM values tend to pass criteria validity tests. This suggests that satisfying incentive compatibility and consequentiality requirements are a prerequisite for experiments that we can use for interpreting criterion validity.

3.4.2 Convergent Validity

Convergent validity concerns the correspondence between a measure and other measures of the same theoretical construct. To the extent that a correlation exists, the validity of each measure is supported. For instance, various studies have compared CVM with TCM and hedonic price measures to show convergent validity. While convergent validity tests of this type are not possible for passive use values, they can be carried out for private or quasi-public goods, such as recreational resources. Many studies have used both stated and revealed preference methods to examine how the environment conveys value through recreation and this study is one of them.

Carson et al. (1996) utilize 83 studies from which 616 comparisons of CVM to revealed preference (RP) estimates are made. The convergent validity of the two measurement techniques is closely tied to the presence of a significant correlation between the estimates derived using different techniques, and this study finds that the correlation coefficient estimates are significant under both Pearson correlation coefficient and Spearman rank correlation coefficient.

3.4.3 Construct Validity

Construct validity answers the question of whether Stated Preference estimates are consistent with theoretical predictions. It was one of the main means for researchers to assess the efficacy of stated preference method before the experimental revolution and advent of research using both stated and revealed preference methods.

Some criteria are readily available when evaluating the construct validity of contingent valuation response. They include: (1) when the requested payment amount falls, the proportion of people willing to contribute to an environmental good in a stated preference survey should increase; (2) people should be willing to pay more to have a higher quantity or quality of the good; (3) the income elasticity of WTP should be larger than one as environmental goods are recognized as luxury goods; (4) WTP and WTA for environmental changes should not be substantially different. However, the criteria (2) and (3) are sensitive to fixed quantities and limited substitutability with other consumption goods, and (4) has been discussed previously.

A test of the hypothesis about the effects of certain features of a scenario on the mean value of the sample is known as the “scope test”. For instance, an increase in the quantity or the quality of the good being valued should produce an increase in the magnitude of expressed values. The NOAA Panel (1993) recommended including a scope test in its guidelines. Though some studies have found that estimates of economic value did not go up when the scale of the environmental good was increased, many studies have shown that scope effects are typically present in well-executed studies (Carson, 1997; Smith and Osborne, 1996; Brouwer et al., 1999; Ojea et al. 2011). A second set of tests focus on the income elasticity of WTP. Flores and Carson (1997) show that the income elasticity of WTP for an environmental good depends on three adjustment margins[1]. Horowitz and McConnell (2002) use Sugden's result to show that the effect of income on WTP can be approximated from information on the ratio WTA/WTP. They conclude that the data are not consistent with neoclassical preferences based on the meta-analysis of 201 WTA/WTP ratios. Furthermore, the big difference between WTP and WTA in many studies seems implausible. However, Horowitz and McConnell (2002) found evidence showing that the divergence is not mainly due to the hypothetical nature of stated preference after reviewing 45 studies. Thus the divergence does not directly indicate construct invalidity.

Researchers are now less likely to draw conclusions about construct validity based on narrowly interpreted tests of scope, income effects, and the sensitivity of value estimates to the detail of the constructed market. Instead the criteria used to evaluate construct validity are case-specific and start with questions about the extent to which the specific predictions fit with the specific context. (Kling, Phaneuf and Zhao 2012)

3.4.4 Content Validity

Different from the other types of validity, content validity correlates to how effectively a stated preference study adheres to the current state of the art and cannot be accessed by

[1] Three margins are: the implied income elasticity of demand for the environmental good, the substitutability among all the quantity-constrained goods, and the share of augmented income allocated to market goods.

summarizing general evidence. The criterion of assessing whether a stated preference method satisfies content validity is whether “best practices” are being followed. Some attempts have been made to more objectively define best practice. For example, the NOAA Blue Ribbon Panel (1993) reviewed CVM in the context of assessing damages to natural resources in support of litigation and provided its guidelines for best practice. After that, the “best practice” has evolved a lot in recent decades.

It is now widely accepted that the environmental good needs to be described with a high level of specificity, which can help to improve the study’s sensitivity to scope and other theoretical conditions. In contrast, a vague or abstract commodity definition is considered a failure of content validity (Kling, Phaneuf and Zhao 2012). In addition, researchers also prevailingly support that the constructed market should represent a realistic mechanism for proposed change and the payment mechanism needs to be something that respondents find realistic and are familiar with. Lastly, researchers’ understandings on the constitution of an incentive-compatible elicitation mechanism have evolved to use a referendum format. It’s also of great importance to design an actual payment vehicle, commodity provision details and design elements related to voluntary versus coercive payment. Likewise, framing the survey to be consequential, the presentation of cheap talk scripts, and the use of certainty follow-up questions have, in various combinations have become common practice.

In addition to the aforementioned types of validity, the issue of reliability is also a concern. Reliability usually refers to the extent to which the variance of a response or estimate is a result of random resources or “noise”. The variance mainly depends on three factors. The first one is the true underlying variation in WTP for the good in the population. The second factor is the concepts, wording and method of presentation. The third source is whether the sample is selected to represent the population. Many techniques and efforts are used and paid to enhance the reliability of a CVM study's WTP amounts since if the sample are inappropriate selected, the reported WTP may be very different from the true WTP amount for the good. Furthermore, if an instrument leaves respondents confused, it engenders respondents to rely on cues in the instrument rather than prompting them to search for their preference and systematic error or bias will arise then.

CHAPTER 4

THE TRAVEL COST METHOD

As one of the most prevalent approaches of revealed preference methods, the travel cost method (TCM) can be used to estimate welfare effects of various kinds of public actions, from eliminating access to a beach, fishing site or other recreational resource, to changing the quality of a site such as improving fishing or reducing pollution. The TCM is a model of the demand for the services of a recreational site, the essence of which stems from the need to travel to a site to enjoy its services. All methods that use travel costs rely on the insight that differences in costs cause differences in quantity demanded. (Haab and McConnell, 2002)

The TCM was developed earlier than the CVM, rising initially in the context of a debate over the use of public lands in western United States. Harold Hotelling (1947) first suggested the TCM in an unpublished letter in response to federal inquires about how to value public land. He described a method for valuation of public lands by estimating the travel time and cost to reach the destination and argued that the costs of travel is an implicit price that could serve to generate an estimate of consumer surplus by modeling the number of visits from various distances from the site (Phaneuf and Smith, 2005). In one of the earliest applications, Clawson (1959) computed visitation rates per 100,000 population to the major national parks in the United States by cost. Another early study was conducted by Trice and Wood in 1958.

4.1 Benefit and Measurements

The TCM is a model of the demand for the services of recreational sites, it can be used to value either the access to the sites or the characteristics of the sites. Since the TCM typically uses observations on price and quantity, the demand curve derived is an ordinary, or Marshallian, demand curve (Ward and Loomis, 1986). When one integrates under this curve between any two prices, the result is the Mashallian consumer surplus. Though it is not the desired compensating or equivalent variations derived from a Hicksian demand curve, Willig (1976) has demonstrated that observed consumer's surplus can be rigorously utilized to approximate the unobservable compensation variation (CV) and equivalent variation (EV), which are the correct theoretical measures of the welfare impact of changes in prices and income on individual.

Different from CVM, the TCM is limited to measuring the on-site recreation benefits provided by a natural resource. The benefits estimated from TCM include neither any option values to future use nor any existence values.

When the TCM is employed for measuring the benefits and costs of public actions, it can be used in two ways. One is to determine the "access value" to a site to evaluate the best use of public land including both commercial and recreational uses. The other is to measure the benefits of changes in the policies that influence the quality of the sites. There are two broad approaches to estimating the demand for recreation sites using the TCM. The first approach assumes a utility function for site services and derives the demands. The alternative approach is to estimate the demand functions for sites directly, rather than specifying a utility function. In the next part of this chapter, I will briefly review these two approaches separately.

4.2 Elicitation Approaches

4.2.1 Demand Function Approach

4.2.1-1 Zonal Travel Cost Model

The original form of TCM initially employed by Clawson and Knetsch (1966) is referred to as a zonal or aggregate model. This approach consists of forming concentric circles around the destination, so that a given zone, the area between two concentric circles, represents a relative nondegenerate distance and hence a given travel cost (Haab and McConnell, 2003). In applications, distance zones are typically replaced by political jurisdictions, such as counties. An ordinary least squares regression is often used to develop a linear relation between the travel cost (tc_i) and the per capita visitation rate (v_i).

$$v_i = \alpha + \beta * tc_i \qquad 4.2.1\text{-}1(1)$$

where i indicates the zone. When an entrance fee (given by f) is applied, which, in effect increases the origin price, the regression form will be given as:

$$v_i = \alpha + \beta * (tc_i + f) \qquad 4.2.1\text{-}1(2)$$

Individual behavior models have supplanted this zonal approach because the zonal models require aggregate visitation data, which is often unavailable. Zonal models also make the questionable assumption that behavior of individuals within a zone is identical. This will result in the loss of information efficiency because of using highly aggregated data and inability to separate out the influence of travel time from travel cost (Ward and Loomis, 1986).

4.2.1-2 Basic Single Site Travel Cost Model

The single-site model is a demand model for trips to a recreation site by a person over season. Its simplest form is

$$r = f(tc_r) \qquad 4.2.1\text{-}2(1)$$

where r is the number of trips taken by a person in a season to the site and $\mathrm{tc_r}$ is the trip cost of reaching the site. Besides trip costs, individual demand for recreation trips depends on factors such as income, age, experience, proximity to other substitute sites, etc. Then the form can be further specified as:

$$r = f(tc_r, tc_s, y, z) \qquad 4.2.1\text{-}2(2)$$

where y is income, z is a vector of demographic variables, and $\mathrm{tc_s}$ is the price of trips to substitute sites. In a linear version, it can be given as:

$$r = \beta_{tc_r}tc_r + \beta_{tc_s}tc_s + \beta_y y + \beta_z z \qquad 4.2.1\text{-}2(3)$$

4.2.1-3 Count Site Travel Cost Model

In most modern single-site applications, the model is estimated as a count data model considering the non-negative integer and truncated nature of the dependent variable (i.e. visitation rate). The basic count data travel cost model is a Poisson regression, in which the number of trips taken by a person to a site in a given season is assumed to be generated by a Poisson process. Then the probability of an individual taking r trips in a season is:

$$\Pr(r) = \frac{\exp(-\lambda)\lambda^r}{r!} \qquad 4.2.1\text{-}3(1)$$

The parameter λ is the expected number of trips and is assumed to be a function of the variables specified in the demand model. To ensure nonnegative probabilities, λ usually takes a log-linear form:

$$\ln(\lambda) = \beta_{tc_r} tc_r + \beta_{tc_s} tc_s + \beta_y y + \beta_z z \qquad 4.2.1\text{-}3(2)$$

The parameters in this equation are estimated by maximum likelihood. The likelihood of the actual visit is the product of these probabilities given by

$$L = \sum_{n=1}^{N} \frac{\exp(-\lambda_n)\lambda_n^{\,r_n}}{r_n!} \qquad 4.2.1\text{-}3(3)$$

where n denotes the individual, $n = 1,2, \dots, N$. For individual n, the surplus is

$$S_n = \lambda_n / -\beta_{tc} \qquad 4.2.1\text{-}3(4)$$

Negative Binomial models are also general forms of a count data model where the Poisson Model assumption about the equality of the mean and variance is relaxed by incorporating an additional error term to account for systematic differences. For more detail, refer to Haab and McConnell (2002).

4.2.1-4 Multiple Site Travel Cost Model

To partially address the substitution effects between sites, multiple site travel cost models were developed correspondingly, which is also better suited to examining the effect of site quality on site choice demand. Multple site models are often estimated by a series of demand equations for each site j.

$$r_{ji} = r_j(p_{r_{ji}}, p_{r_{ki}}, M_i, q_j) \qquad 4.2.1\text{-}4(1)$$

where $\mathrm{i} = 1,2, \ldots, \mathrm{n}$ and $\mathrm{k} = 1,2, \ldots, \mathrm{m}$ and $\mathrm{k} \neq \mathrm{j}$.

Problems arise as the number of the sites becomes large since the system of equations will become difficult to estimate and must be simplified. Two simplifications are proposed in Freeman (2003): one is to treat the site most traveled to by an individual as a typical site visited and assume that all trips taken are to this typical site, and the other is pooling all trip date into one demand equation. Though the method can largely consider substitution between sites, as the number of sites become large, assumptions and simplifications of the model that are unlikely to resemble reality have to be made (Perman et al., 2003). Besides, it is impossible to measure welfare effects of changes in site quality without placing strong restrictions on this type of model (McConnell and Strand, 1991).

4.2.2 Utility Function Approach

Discrete choice models describe a decision maker's choice among alternatives. To fit within a discrete choice framework, the set of alternatives, called the choice set, needs to exhibit three characteristics. First, alternatives must be mutually exclusive from the decision maker's perspective. Second, the choice set must be exhaustive, in that all possible alternatives are included. Third, the number of alternatives must be finite.

The random utility discrete choice models are derived under an assumption of people's utility-maximizing behavior. When a decision maker faces a choice among different alternatives, he will choose the alternative that provides the greatest utility. The behavioral model is therefore: choose alternative i if and only if $U_{ni} > U_{nj}, \forall i \neq j$. The researcher observes some attributes of the alternatives as faced by the decision maker, labeled x_{nj} , and some attributes of the decision maker, labeled s_n, thus a function that relates these observed factors to the decision makers' utility can be specified and denoted as

$$V_{nj} = V\ (x_{nj}, s_n) \qquad 4.2.2\text{-}1$$

which is also called representative utility, and the true utility

$$U_{nj} = \ V_{nj} + \varepsilon_{nj} \qquad 4.2.2\text{-}2$$

In the above equation, ε_{nj} captures the factors that affect utility but are not included in V_{nj} and is treated as random. The joint density of the random vector $\varepsilon'_n = [\varepsilon_{n1}, \varepsilon_{n2}, \dots, \varepsilon_{nJ}]$ is denoted as $f(\varepsilon_n)$. So the probability that decision maker n chooses alternative i is

$$\begin{aligned} P_{ni} &= Prob\big(U_{ni} > U_{nj}\big) \qquad 4.2.2\text{-}3 \\ &= Prob(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}\ \forall i \neq j) \\ &= Prob(\varepsilon_{ni} - \varepsilon_{nj} > V_{nj} - V_{ni}\ \forall i \neq j) \end{aligned}$$

Using the density $f(\varepsilon_n)$, this cumulative probability can be rewritten as

$$\int I(\varepsilon_{ni} - \varepsilon_{nj} > V_{nj} - V_{ni}\ \forall i \neq j) * f(\varepsilon_n)\ d\varepsilon_n \qquad 4.2.2\text{-}4$$

where I is the indicator function, equaling 1 when the expression in parentheses is true and 0 otherwise.

4.3 Welfare Analysis

By definition, a person's consumer surplus is the net utility, in dollar terms that the person receives in the choice situation. The decision maker chooses the alternative that provides the greatest utility, and the consumer surplus is therefore

$$E(CS_n) = \frac{1}{\alpha_n} E[max_j(V_{nj} + \varepsilon_{nj})] \tag{4.3.1}$$

where α_n is the marginal utility of income. Usually, a price or cost variable enters the representative utility, in which case the negative of its coefficient is α_n by definition. $E(CS_n)$ is the average consumer surplus in the subpopulation of people who have the same representative utilities as person n. By weighting the sum of $E(CS_n)$ over a sample of decision makers with the weights reflecting the number of people in population, total consumer surplus in the population can be calculated. This is analogous to equation (3.3.3) in the previous chapter.

The change in consumer surplus that results from a change in the alternatives is calculated as follows:

$$\vartriangle E(CS_n) = \frac{1}{\alpha_n}\left[\ln\left(\sum_{j=1}^{J^1} e^{V_{nj}^1}\right) - \ln\left(\sum_{j=1}^{J^0} e^{V_{nj}^0}\right)\right] \tag{4.3.2}$$

The superscripts 0 and 1 refer to before and after the change. The coefficient α_n is assumed to be fixed for a given person independent of his income. If not, a more complicated formula is needed, which has been provided by McFadden (1999) and Karlstrom (2000).

4.4 Validity of Travel Cost Method

As discussed in Chapter 3, four types of validity, including content validity, criterion validity, convergent validity and construct validity are frequently used in regards to evaluating the contingent valuation method. Except convergent validity, other validity criteria are seldom mentioned in literature with respect to inspecting the validity of TCM. In fact, there is no reason for us to refuse to apply them to other non-market valuation methods, which to some extent, will help provide more insight to the model we employ. So in the following, I will discuss how validity issues relate to travel cost method.

As it is for CVM, construct validity answers the question whether TCM estimates are consistent with theoretical predictions. From previous empirical results, the coefficient of the price in travel cost model are almost always significantly negative, which caters the theoretical prediction that as the price increases, the visitation rate will go down. In addition, the recreational sites' quality is usually positively correlated with visitation rate in empirical applications, further demonstrating that it is theoretically valid. So the empirical evidence has supported the construct validity of TCM.

Unlike the criteria of assessing content validity of CVM, TCM does not have a strict guidance that can be followed as "best practice". A number of stubborn methodological problems remain and welfare estimates generated by TCM are sensitive to different specifications of the costs and opportunity costs of visiting particular sites (Randall 1994) as well as the specification of demand functions. For instance, the cost of travel time remains an "empirical mystery", although there is general agreement that the opportunity cost of time spent traveling should be counted among the costs of travel.

Early applications of TCM used only round-trip variable monetary transportation cost as the price variable. In subsequent research the joint effect of transportation cost and travel time was found to influence the frequency of people's visitation (Cesario and Knetsch, 1970). Thereafter, conceding that time cost is a major component of price, measurements of the time value became a consideration. Currently, many analysts rely on the travel time values from commuting studies summarized by Cesario and used a value of one-third to one-half the wage rate as the value of travel time. McConnell and Strand (1983) and Ward (1984) demonstrate that one- third the wage rate is a conservative measure of travel time value based on the observe tradeoff travel cost for travel time. Controversy also present in the literature on whether the opportunity costs of on-site time need to be included in the price variable or otherwise incorporated into the demand equations (McConnell, 1975; Cesario and Knetsch, 1976). According to Miller and Hay (1981), one way to account for the role of on-site time in recreation decision making is to estimate different demand equations for trips as a function of length of trip. Specification of the components of the price in TCM will definitely influence the estimate of recreational value.

Much empirical evidence has demonstrated that the choice of demand function affects estimated travel cost values. Kealy and Bishop (1986) estimated recreational value of Lake Michigan based on 1978 mail survey using both ordinary least square and maximum likelihood procedure and found that the failure to use maximum likelihood procedures to estimate the truncated sample data would result in overestimating the value of Great Lakes fishing by 3.5 times. Smith (1988) found, for a given estimation procedure, the consumer surplus per trip increased by 50% when the semilog rather than the linear demand function is estimated. Kling (1988) found that semilog demand functions sometimes yielded estimates of consumer surplus twice the estimates of the linear demand functions, even when the true arguments and random process were known.

In addition, allocation of costs of owning and maintaining vehicles and other equipment to any particular trip seems to lack a general approach. For instance, treatment of multi-purpose, multi-site trips and substitute sites largely influences the welfare estimates generated with TCM empirically, which should also be paid much attention. (e.g., Rosenthal 1987)

During the development procedure, TCM has shown large improvements in estimating recreational value from the zonal approach to random utility models. McConnell (1992) addressed some general mistakes that usually occur in TCM and proposed some approaches to avoid potential errors in estimation and calculation of benefits, which to some extent can be regarded as the guidance for practice. In this sphere, the content validity of TCM can be realized.

The convergent validity of TCM, which is usually combined with the discussion of CVM in parallel, has been discussed most among all validity types in previous literature. Since to the extent that a correlation exists between TCM and CVM, the validity of both measures are confirmed. This study uses both TCM and CVM to estimate the recreational value of fishing sites in New York State, also partially aiming at investigating the convergent validity of both methods. So the study result itself addresses this validity problem.

As noted in the previous chapter, the criterion validity of CVM is also a heated topic that has been discussed by multiple researchers. Yet such issue has apparently not been discussed extensively for TCM. By definition, criterion validity is concerned with whether the measure of the construct is related to other measures, which may be regarded as criteria. But currently, such criterion is difficult to find for evaluating the criterion validity of TCM.

As stated in Randall (1994), the problem of obtaining valid absolute welfare measures from TCM could conceivably be solved in two ways. One could adjust the cost-accounting and analytical conventions until TCM reliably generates welfare measures consistent with some benchmarks established using fundamentally different valuation methods, Alternatively, one could calibrate the TCM estimates using welfare information generated by fundamentally different methods. Either way, TCM cannot stand alone.

CHAPTER 5

CONVERGENT VALIDITY - RELEVANT LITERATURE

The Travel Cost Method (TCM) and Contingent Valuation Method (CVM) are widely used in studies attempting to determine the value of recreational activities. Beginning with Knetsch (1994), the comparison of CVM estimates for government-provided, quasi-public goods with estimates obtained from revealed preference techniques, such as travel cost analysis, has played an important role in assessing the validity and reliability of the CVM. However, among the studies that have made comparisons between the TCM and CVM, none of them is focused on comparing an open-ended CVM with TCM employing random utility models (RUM). Additionally, among all the comparison studies, none of them derives evidence from New York State anglers. To make a comparably inclusive review on studies employing both of these two non-market valuation methods, a wide range of articles including published papers, conference papers and government reports, etc. are summarized below in three categories, based on the relationship of their estimates of TCM and CVM.

5.1 TCM Higher Than CVM

[5.1.1] *Economic value of Idaho Sport Fisheries with an update on valuation techniques (Sorg et al. 1986); Net economic value of cold water and warm water fishing in Idaho (Sorg et al., 1985); Net economic value of recreational steelhead fishing in Idaho (Sorg et al., 1985).*

Three sequential studies on the economic value of Idaho fisheries were conducted, including cold water, warm water and steelhead fishing types. This research, which was presented in two USDA Forrest Service reports and a journal article, was to compare use values obtained from a regional TCM approach with those obtained from a CVM for the same resources.

Two surveys were conducted in 1983 separately focusing on warm, cold-water fishing and steelhead fishing type. The response rate for the mail and telephone survey was 99% across both surveys. The travel cost survey, using the same survey as contingent valuation, asked respondents to recall all their recreational fishing trips taken during the entire survey period in 1982. Rather than specific sites, 51 "map unit" areas in Idaho were provided and respondents were asked to provide average trip information for areas they visited more than once. In addition, standard travel cost information was collected, including purpose, primary species targets, number of trips taken, number of people in party, distance traveled, number of days and hours per day fished. A pooled regional travel cost model was conducted based on collected data. Self-reported distances were converted to dollar values and opportunity cost was set to be one-third of the wage rate obtained from the U.S Department of Labor. For the regression, the dependent variable is trips per capita adjusted by population differences between counties of visitor origin, and the independent variables include round trip distance from their county to fishing site, total fish caught, and substitute site attractiveness. Coefficients on independent variables were found to be significant and in the direction expected; trips per population was negatively related to distance and substitute site measures, and quadratically related to catch rates and income. In contrast to the travel cost data, which pertained to the entire season, contingent values were collected for only the last fishing trip of the season. An iterative bidding procedure was used starting with 20% higher than the current cost of the trip.

Best estimates for primary purpose Cold-water, Warm-water and Steelhead fishing values are $42.90, $42.18 and $27.87 per trip ($25.55, $26.36 and $14.29 per day) for TCM in current conditions, and are \$22.52, \$24.62, and \$31.45 per trip (\$14.25, \$12.02 and \$20.29 per day) for CVM. The report also gave estimates of CVM for non-primary purpose trips, of \$39.71, \$19.36 and \$45.71 for Cold-water, Warm-water and Steelhead fishing separately. The general finding from the comparisons of TCM and CVM undertaken found that travel cost estimates consistently exceeded contingent values for each of the species considered. The authors suggest that this could be due to the fact that the CVM bids were for the last trip taken whereas the travel cost gave the value over all trips taken that year.

[5.1.2] *Testing for convergent validity between travel cost and contingent valuation estimates of recreation values in the Coorong, Australia. (Rolfe and Dyack 2010)*

This article, published on the Australian Journal of Agricultural and Resource Economics, aims at estimating the recreational values associated with the Coorong on the Murray River in the southeastern Australia using both TCM and CVM. Both methods used the same data collected from a sample of recreational users at the site using a paper-based visitor interception questionnaire administered in a drop-off/collect format at each site. Visitors to the sites were approached at random to complete the survey, which was conducted over a four month period from January to April 2006, a total of 790 questionnaires were completed, thus resulting in a 88.8% overall response rate.

For the TCM, a negative binomial model was used with a truncated form of the model to correct for endogenous stratification. The dependent variable is the frequency of visits, and the main independent variable, travel cost, was estimated as a function of distance travelled with variations for the car size, together with additional costs such as accommodation (excluding foods) and an allowance for travel time at one-third of the average Australian wage rate. The value of on-site time was not included in travel costs. Other dependent variables include income, age, a dummy for whether respondents believe environmental problems decreasing, and dummies for different activities (i.e. swimming, fishing, canoeing, four-wheel driving). The consumer surplus was estimated at $149 per adult person per visit day

For the CVM, a dichotomous choice (referendum) approach was used, and a question following the TCM was given by: “If the trip had cost $X more for you for whatever reason, would you have still decided to come to the Coorong?” In response, people can choose one alternative from “yes”, “no” and “not sure”. Six different levels were randomly offered to recreation users for the payment bid in this experiment ($10, $20, $50, $100, $200 and $400). The “not sure” responses were coded as “No” responses for the data analysis in line with common practice (Ready et al., 1995; Blamey et al., 1999). A standard logistic model was estimated using maximum likelihood methods and the estimates of consumer surplus were calculated using the equation: $Mean\ WTP = (1/\beta_1)\ * ln(1 + e^{\beta_0})$, where WTP is willingness to pay, β_1 demotes the coefficient of travel cost (or price) and β_0 is the intercept. The estimate of recreation value per adult visitor per day is $116 under CVM method.

The result shows that the estimated recreational value using CVM is significantly lower than using TCM at the 10% level. A number of methodological and framing issues to explain the differences were tested in this article. The evidence from the study suggests that the most important of these are likely to be the different decision points underpinning data collection and the consideration of substitute sites, strategic responses and the treatment of uncertain responses within the CVM.

However, some specific methodologies employed here should be paid attention. The researcher gives the estimate of recreation value of CVM based on a functional form that tends to give overestimates considering the ignorance of negative WTP values (Johansson et al., 1989; Hanemann 1989). Besides, the article provides evidence that estimated value using TCM is significantly lower than using TCM at 10% level, which is a comparably weaker statement than providing evidence of significance at 5% or even 1% level. So based on these, we should not hastily conclude that the value estimated under TCM is evidently significantly larger than that estimated under CVM.

[5.1.3] *Economic valuation of the benefits of recreational fisheries in Manzanillo, Colima, Mexico (Chavez-Camparan and Fische, 2001)*

This article, published on Tourism Economics, aims at estimating the economic benefits derived from recreational fisheries in Manzanillo by applying two economic valuation methods: TCM to estimate the economic benefits of the overall recreational fishing experience and the CVM to estimate the economic benefits for just the sailfish recreational fishing experience. Two surveys were carried out in Spanish, among which one was a mail survey using a questionnaire applying the dichotomous format CVM and TCM. The other is person-to-person survey and only open-ended CVM was applied. The mail survey was conducted in February 1997 and was sent to 1,018 anglers, with 126 individuals returning the survey. This resulted in a 13.2% adjusted response rate after considering 64 questionnaires that were sent to a wrong address. The person-to-person survey was done in November 1998 with all 130 anglers who participated in the sailfish tournament, which gave a nearly 100% response rate.

For the TCM, both a semi-log and a linear demand equation were estimated using Ordinary Least Square (OLS) method. The number of trips to Manzanillo throughout the year 1996 is used as dependent variable in the semi-log demand equation. Travel cost to Manzanillo, travel cost to substitute sites, demographic variables, opportunity cost and site quality serve as independent variables in the equation. Travel cost was taken as the round-trip distance plus the average cost in Mexico of gasoline (consumed at an average velocity of 110 km/hr estimated at 0.42 pesos per kilometer). Alternatively, respondents were asked to name the substitute sites they also fished and the travel cost was calculated in the same way. Demographic variables include income, age, education and fishing experience. In addition, the opportunity cost in this study of the time from the origin of the angler to Manzanillo was established as 0%, 25%, 33%, and 50% of the salary, and they are integrated into the travel cost separately to elicit the influence of time cost on visitation. On site time cost was directly ignored here, following Pearce and Makandya (1989). Moreover, a subjective quality index of fishing in Manzanillo was developed as compared with other places (i.e. 1=excellent; 2=good; 3=equal to other places; 4=bad fishing).

For the dichotomous choice format CVM, anglers were asked whether or not (i.e. "yes" or "no") they would pay a specified amount to use the resource. Then respondents were asked: "Are you willing to pay for this permit $X pesos per fishing day for the opportunity to continue fishing for sailfish, instead of not doing so because of the disappearance of this resource?" Eighteen different bids ranging from 10 to 400 was established. In addition, to detect any protests-zero bidding by the anglers, respondents who offered zero bids were asked to choose reasons from several possible answers[1]. Respondents who are believed to provide zero bid

[1] (1) Willing to pay only a small amount; (2) society has more important problems to deal with; (3) angling for sailfish is not worth it for me; (4) government should pay for protection with our taxes; (5) more information is

protests were excluded from the analysis (15/126). A logistic equation was estimated using Ordinary Least Squares (OLS).

For the open-ended CVM, two hypothetical questions were asked to estimate the preferences of the WTP of the anglers in order to detect bias. The first question (WTP1) specified the conservation program for the sailfish only and the question is given as: “What is your WTP $X pesos per year for the conservation of sailfish in order for you to still fish with an adequate level of success?” Alternatively, the second question (WTP2) was designed to see if there was a WTP for the conservation of more than one species of fish reserved exclusively by law for sport fishing. In addition, 2.9% (3 cases) of respondents were eliminated because of a negative attitude towards government management of fish resources rather than because of a methodological problem in the CVM. Though not discussed in detail, a starting point bias between WTP1 and WTP2 is detected by using a regression analysis.

The results indicate a fishing value of $39.10 per day for the total recreational fishing experience using the TCM, $22.57 per day using the CVM in a dichotomous format and $7.14 per day using it in an open-ended format. The value estimated from TCM is significantly higher than both the CVM estimates. This relationship between values obtained from dichotomous choice and open-ended CVM elicitation methods is consistent with the broader literature in valuation (see Boyle et al., 1994; Balistreri et al., 1998; Cameron et al. 2002)

5.2 CVM Higher Than TCM

[5.2.1] *The economic benefits of surface water quality improvements in developing countries: a case study of Davao, Philippines (Choe, Whittington and Lauria 1996)*

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needed before deciding; (6) I object to the way that this issue is treated; and (6) other reason (the respondent was asked to specify).

Choe et al. (1996) conducted a research to estimate the economic value that people in Davao place on improving the water quality and compare the use value estimates obtained from TCM with those obtained from CVM for the same resource. Data for both valuation methods were collected using the same questionnaire, involving a random sample of 1,200 households drawn from the general population of Davao in a two stage stratified form. For the contingent valuation question, a split sample design was used to divide the sample into three Groups. The overall response rate for the survey was 65% from both users and nonusers. Travel cost data were collected from users only.

In the contingent valuation section, all household in Group2, Group3 and half the people in Group1 were asked to vote on whether they would support a citywide plan to clean up the river and make Time Beach safe for recreation at a specified monthly price, which was called the referendum question. The price include amounts in 25, 50, 100, 150 and 200 pesos were randomly assigned to respondents, and if their answer was "yes", they would be asked to answer following yes/no questions with ascending prices following an iterative bidding approach. If their answer was "no", a final open-ended question regarding their maximum WTP would be asked. A scope test was conducted to test the internal validity of the CVM estimate by asking remaining households in Group1 on how they would vote on a more comprehensive plan that provided additional construction of sewer lines and treatment of wastewater. A higher percentage of households supporting the second plan would lend the validity of the estimate.

Three different ways were used to estimate household WTP. The first approach was an average of respondent's answers to the highest value they said "yes" and if they never indicated a "yes" response then the open-ended value was used. In the second approach, survival analysis was used to estimate mean and median of the WTP distribution by censoring the bids according to the respondent's first two yes/no questions and assuming four different distributional forms of their WTP. The third approach used the answers for the initial referendum question only, and a "single bounded" probit model was used to explain these initial votes. Four independent variables, including household income, education, whether the respondent lives in a flood zone and whether used Time Beach before were found to be positively and significantly related to households' answers to the referendum question. Households that used Time Beach before were willing to pay about 40 pesos per month, while nonusers just willing to pay half as much.

For the travel cost approach, a simple single site TCM was used to estimate the difference in the economic benefits recreational users obtained from activities before and after the public health advisory regarding pollution at Time Beach. The self-reported visitation rate before and after the advisory were used. The number of annual visits to Time Beach by households was specified as an additive function of travel cost, household income, preferences, the availability of substitute sites and water quality. The opportunity cost was assumed to be equal to one half of the household's hourly wage rate and the distance was measured on topographic map from each barangay to Time Beach. All substitute sites were within one-day excursions, however, the method of calculating the travel cost was not clearly specified in article. Both Tobit and OLS models were used to estimate the visitation rate equation and they gave estimates of WTP of 51 pesos and 36 pesos respectively.

This study expected that the CVM estimates should be higher than TCM estimates, though it was not true for Tobit model. This may be because the TCM measures the use values lost by the household while the CVM captures both use and nonuse values. Additionally, CVM might have elicited respondents' WTP for cleaning up both Time Beach and other beaches while the TCM might only include Time Beach.

[5.2.2] *Joint Estimation of Revealed and Stated Preference Data: An application to recreational red snapper valuation. (Gillig et al., 2003)*

The aim of this article, which was published in Agricultural and Resource Economics Review, is to estimate the value of recreational red snapper fishing in the Gulf of Mexico employing Contingent Valuation Method (CVM), Travel Cost Method (TCM) and joint CVM-TCM model.

Most of the data were obtained from a survey of Gulf of Mexico reef anglers, administered by KCA Research, Inc., for the National Marine Fisheries Service (NMFS) during 1991. About 353 observations or 41% of the total number of respondents are usable. Among these usable responses, only 68 observations, which are identified to be red snapper recreational fishing trips, remained for the analysis.

For the TCM, each observation in the sample makes at least one trip to the recreational site, thus the number of recreational fishing trips, is truncated at one. The recreational fishing trip demand is incorporated with price, income, catch rate, and fishing experience as independent variables and the number of trips as dependent variable. The opportunity cost of time is included in the price (or travel expenditure) variable associated with the recreational trip and the round trip travel time is calculated as distance from home to recreational sites (distance miles/45 miles per hour). Following McConnell and Strand (1981), this study chooses a value of 0.612 of hourly income as opportunity cost per hour. Additionally, the catch rate variable was constructed by first averaging the catch rates for the years 1989 and 1990 for different areas in the Gulf of Mexico and then assigning each angler an average catch rate based on the area in which the angler fished. The catch rate is approximated by the keep rate and is used as a proxy for the expected fishing quality. Assuming a normal distribution of error term, the density of truncated random variable (the number of trips) can be obtained, as well as the log-likelihood function. Following the Maximum-Likelihood procedure, the coefficients and fishing values can be then estimated.

For the CVM, the respondents are first given a randomly selected price to maintain the current red snapper catch rates and then are asked if they are willing to pay that price. The response to the "yes/no" question is assumed to depend on a latent variable, which depends on a vector of explanatory variables. A respondent will answer "yes" to the question when the latent variable is positive, and answers "no" otherwise. Then the probability of a respondent answers "yes" can be calculated, so as the log-likelihood function. Following the Maximum-Likelihood procedure, the fishing value can be estimated under CVM. We will not talk in detail about the joint CVM-TCM model here.

The result shows that the CVM yields the highest value $85.7, which is calculated as the median WTP using the standard probit specification. The truncated TCM yields $9.85, which is significantly lower than the value yield by CVM. The WTP of the joint model falls in between at $14.50.

5.3 CVM and TCM not significantly different

[5.3.1] *Angler preference study final economics report: Contingent valuation of Montana trout fishing by river and angler subgroup. (Duffield and Allen, 1988)*

The objective of this report was to provide contingent valuation estimates of net economic use values for trout fishing on nineteen Montana Rivers and estimate the net use values associated with changes in fishery quality. It also aimed to explore the issue of market definition of the types of recreation experience, in order to show net economic values vary across user groups. The study is based on the Angler Preference Survey, administered by the Montana Department of Fish, Wildlife and Parks in the summer and fall of 1986. A total of 2,672 questionnaires were mailed in the summer and fall of 1986 and 2,171 completed questionnaires were received in a response rate of 81%, indicating a keen interest in Montana fisheries.

This report used CVM and TCM approaches (not detailed in this report) to estimate net economic value Two specific versions, open-ended and dichotomous choice formats were employed in the contingent valuation approach, each of which have their advantages and deficits during valuation procedure. The researchers argue that a problem with open-ended responses is how to interpret extremely high and zero values. Respondents may also find the question difficult to answer. Though dichotomous choice questions are simple to answer (just yes/no), it requires fairly complex analysis to determine willingness to pay. A longstanding issue in CVM is whether the two approaches yield consistent results.

In this study, the design of the dichotomous choice and open-ended surveys and their specific model forms were illustrated explicitly. For the dichotomous choice method, three specific questions were developed. One question addressed the willingness to pay for the current conditions, and the other two doubled the chance of catching large trout and overall catch rate respectively. First, respondents were asked what their total trip expenditures were for their most recent trip and then asked if the trip was worth more than that expenditure. If the answer was "yes", this was followed by a dichotomous choice CVM asking if they would still have made the trip if share of expenses had been (bid amount) more, with randomly assigned bids ranging from $1 to $500 This was followed by further contingent valuation questions regarding WTP for increased catch rates. The results of these questions are not explored here because they have no travel cost counterpart. An open-ended, follow-up CVM was directly asked after the dichotomous choice question regardless of whether he respondent answer “yes” or “no” to the dichotomous choice question: “What is the maximum increase in your actual trip cost you would have paid to fish in river instead of having to fish elsewhere?” To identify protest responses, this was followed up with a question requesting people who answered zero gave a brief explanation. Further questions about reasons for fishing were asked, and cluster analyses were applied to identify subgroups of fishermen. The working hypothesis is that the economic value will be significantly different across subgroups consistent with the socio-economic and preference variables that characterize the experience types.

The simulated mean value from the dichotomous choice contingent valuation responses for current conditions using the complete sample and logit estimates is $90.74 (n= 1751) responses. This is comparable to the net value per trip based on regional travel cost model reported in Duffield et al. (1987), in which the standard cost estimated using objective distances and mileage cost is $54 and the average self-reported travel cost is $116. In the open-ended CVM, the mean for current condition using the complete sample is $28.54. Protest question responses were coded to exclude respondents who didn’t give responses consistent with economic behavior. To ensure that all of the zero responses are really valid, a test for the consistency with the logit responses was conducted. It was determined that a large portion of the sample responses are inconsistent across the two questionnaire types. In addition, the “yes” response rate for the lowest fixed logit bid amounts averages 90 percent for all logit questions also explained the high share of zero responses in open contingent valuation method. If the zero responses were excluded from the sample, the estimated mean net values doubles to $52 per trip. And if the bids over 500 were excluded for the current condition, the mean drops from $52 to

$42. The single destination-single purpose mean for current condition is $23.59 which is significantly lower than the comparable full sample mean of $32.20, indicating that multi-destination and multi-purpose trip groups includes a large fraction of nonresidents who have a higher WTP.

A comparison of CVM and TCM by river was provided in the report. The travel cost estimates are based on a 1985 survey while the contingent valuation methods are for 1986. The overall price level changes had not been corrected during the comparison.

The TCM estimates are comparable to the current conditions CVM bid questions. The logit mean is $127 (with the distribution truncated at an upper limit of $500) and the TCM estimate is at $122, which is quite similar. In addition, by using the Spearman correlation, which is based on nonparametric methods and shows the similarity in site ranking between methods, the statistic provides very similar results. The correlation between TCM estimates and logit-derived means is quite strong, the logit mean and the open-ended CVM means are also positively correlated, though no significant correlation between the open-ended CVM means and the predicted TCM estimates were detected. Based on this, a basic conclusion was made that the logit mean and the TCM estimates derived from reported costs and the TCMGR are the most consistent of the various estimates. Besides, the ratio of TCM/CVM estimates by site are within 25 to 35 percent range of the corresponding site estimate and it's likely that the TCM and logit CVM estimates are not significantly different. What's more, in a more detailed analysis, the report finds that much of the differences between the two methods appear to be largely attributable to limited samples.

Another perspective on comparison of alternative estimates is provided by bivariate linear regression, which means that the logit mean and open-ended CVM means are regressed on all four TCM estimates. While the overall equation is not significant, the logit means and TCMGM values shows a good fit, which indicates a good correlation between them.

[5.3.2] *The use of contingent valuation data for benefit/cost analysis in water pollution control (Mitchell and Carson, 1986).*

The objective of this report was to value the benefits of water pollution control regulations, using a national data set to make aggregate benefit estimates for different levels of national freshwater quality. While this study was not directed at fishing per se, fishing is likely a part of the WTP for water quality improvements. Two methods including CVM and valuation function were used to estimate the welfare effect of specific changes in water quality based on NWBS data (study of national freshwater quality benefits). A comparison was made between the CVM estimate of welfare change in partial quality improvement in this study and an estimate using TCM conducted by Vaughan and Russell (1982). For the CVM study, a personal interview were conducted at 61 primary sampling points in the contiguous United States by the Opinion Research Corporation using experienced professional interviewers. The response rate was 79% with a total number of 813 total interviews. Of these 564 of the surveys yielded usable WTP data (i.e. excluding protest responses and other anomalous behavior)

During the interviewing procedure, researchers conducted extensive questionnaire research to ensure that respondents would understand the scenario and amenity being valued. They described the water quality to respondents in three levels: boatable, fishable and swimmable using a water quality index developed by W.J. Vaughan. When asked to value the boatable minimum level, respondents were asked how much they would be willing to pay in terms of higher taxes and product prices to keep the nation's freshwater bodies from falling below the boatable level. To avoid the starting point bias associate with the then "commonly used bidding game method" (p. 1-7), the elicitation procedure used a grounded payment card format, which means the respondents were divided into five income groups based on their household income and given a payment card containing four WTP amounts for each of the three water quality levels.[1]

The first bid (WTP_F) is the amount given for each of the three WTP questions (boatable, fishable and swimmable). The reconsidered bid (WTP_R)is the amount (whether changed or unchanged) offered after their three first amounts were repeated to them, the total was stated, and they were encouraged to make any revisions they wished. The informed (WTP_I) bid is the amount given after respondents were informed of the range of the amounts households in their income group were actually paying for water (and air) quality. Finally, respondents were asked if they would increase their WTP amounts if their bids were not enough to reach any of the three goals, including the boatable water quality goal. The amounts given after this question is the highest bid (WTP_H).

To elicit welfare effects of partial water quality improvements, two equivalent subsamples (A and B) were asked two different questions separately. Respondents in Group A were asked the "halfway policy" question: "if the best we could do was to raise the minimum

[1] As discussed in Mitchell and Carson (1988), this grounded payment card approach is susceptible to "anchoring effects" (p. 101). In part because of such concerns, the grounded payment card approach has not been widely adopted, with researchers instead preferring an ungrounded payment card method in which payment values start at zero or a reasonably low value for all respondents (see for example, Rowe et al., 1996)

only halfway from fishable to swimmable, will you still be willing to pay your revised amount for swimmable? ” Respondents in Group B were asked the “95%” question: “if five percent of the nation’s water bodies remain at the boatable level, will you still be willing to pay your revised amount for swimmable?” According to the answers, almost nine out of ten who answered the 95 percent improvement said it worth the same to them as the complete improvement (defined as where 99% or virtually all the nation’s lakes, streams, and rivers would be fishable), while only 73 percent were willing to pay the same amount for the halfway improvement as complete improvement. Each person who was unwilling to pay the same amount was asked how much he or she was willing to pay for this partial improvement. The WTP amount for raising 95% of the nation’s water to at least the fishable level is $74, 8% less than the $80 amount for raising 99% to at least this level. The point estimate of the benefits for water quality improvement is derived by multiplying the average reduction in WTPF_R[1] by the number of 1983 United States census households, which gives $490 million.

An estimate made by Vaughan and Russell (1982) using a participation travel cost model can be used to compare with CVM estimates. Vaughan and Russell valued the benefits accruing to fishermen from improving national freshwater so that all water bodies are at least at the fishable quality level. This improvement is equivalent to raising 3% to 5% of the water bodies from quality levels of less than fishable to fishable quality, an increase quite similar to the 95 vs. 99 percent improvement the researcher asked their respondents to value in this study. Mitchell and Carson expected that their CVM estimates would be higher than Vaughan and Russell’s TCM values due to the more inclusive nature of CVM estimate benefits. However, Vaughan and Russell’s TCM estimate of the benefits for this improvement range from 200 - 1200 million

[1] Maximum willingness to pay (WTP) to reach the fishable minimum water quality level.

(1983) dollars with $500 million as the best rough point estimate. Considering the difference in methods and databases, this amount is quite similar to the $490 million point estimate in the CVM study.

[5.3.3] *Comparing Economic Values of Trout Anglers and Nontrout Anglers in Colorado's Stocked Public Reservoirs. (Loomis and Ng 2012)*

This published paper aims at estimating the recreational value of trout and nontrout fishing in 2009 in Colorado State. Both TCM and CVM were employed to elicit the WTP of trout anglers and nontrout anglers separately.

Shoreline anglers and boat anglers in Colorado's stocked public reservoirs were intercepted and mail back survey packages were handed out. In total, 511 surveys were handed out at 11 Colorado reservoirs along Front Range and Western Slopes during 23 sampling days from July to mid-September 2009, and 265 completed and usable surveys were returned by October, resulting in a 51% response rate.

For the TCM, the Poisson count data regression model is used. The Annual Trips are the self-reported annual number of trips taken to the fishing site. The vector of independent variables X_i include:

- *Personal cost of gasoline (PTOTAL_GAS);*
- *The self-reported catch per hour (CATCHPERHOUR);*
- *A dummy variable describe whether the angler used a boat (USE_MOTOBOAT);*
- *Number of people in the fishing group (NUM_PARTY);*

- *Number of household members contributing to house hold expenses (PAYING_HOUSEHOLD);*
- *Angler's highest level of formal education (EDUCATION);*
- *Number of trips taken to other fishing site during survey period (TRIP_OTHERSITES), which is a proxy for the composite price of available substitutes.*

To account for the endogeneity problem that may arise from the possibility that anglers who fish more frequently are more likely to be surveyed than the angler who seldom fish, the researchers subtracted 1 from each value of the response variable ANNUAL TRIPS. This model does not include any variable for travel time since its high correlation with PTOTAL_GAS made the latter one insignificant and thus hindered the use of the TCM for calculating WTP. However, this would result in an underestimate of the consumer surplus (Bockstael et al., 1987; McConnell and Strand, 1981). The mean net WTP is the inverse of the coefficient of travel cost.

For the CVM, the dichotomous-choice elicitation format was used. Anglers were first asked whether they would or not pay a predetermined increase in the cost of their trip. Each angler responded to only one bid amount, but that dollar amount varied across the sample of anglers ranging from $5 to $2000.

WTP estimated from the TCM per angler day consumer surplus is $191.60 for trout anglers and $61.68 for nontrout anglers. For the CVM method, the mean WTP was $196.48 for trout anglers and $73.84 for nontrout anglers. And the median values from the CVM were $164.53 and $56.78 separately. Hence, the values estimated from CVM and TCM are quite close and the article concluded that these two valuation methods demonstrated convergent validity.

However, considering the possibility of underestimation of consumer surplus under TCM, it's reasonable to cast doubt on the article's conclusion on the convergent validity of two methods. Additionally, according to Hanemann (1984 and 1989), who preferred using median to approximate the value estimated under CVM, the deviation between the values estimated under these two methods will be further exaggerated.

[5.3.4] *An economic assessment of marine recreational fishing in the southern California. (Wegge et al., 1986)*

The objective of this report was to investigate the economic importance of marine recreational fishing in Southern California. A two-phased research design was conducted, among which, the first phase was to review the existing studies and the second was focused on collecting and analyzing original data on marine recreational fishing participation in Southern California. Both the CVM and the TCM were used to estimate the fishing value on three different fishing modes using the same mailing survey data in this study. The three modes are party/charter boat, private/rental boat and shore fishing.

The target populations for the survey were anglers who either fished in Southern California marine waters or who departed from a landing or dock in the coastal area between point Conception and the Mexican border in 1983. The survey sample was randomly selected, using systematic sampling from a membership list of South Coast Sport fishing magazine with the frame stratified by 5-digit Zip code areas to obtain greater representation of anglers who lived within 40 miles of the coast. Between May 22, 1984 and June 21, 1984, a total of 1,193 questionnaires were returned out of 2,915 questionnaires mailed out. This resulted in a 47.40 percent response rate.

For the TCM approach, two demand equations were estimated for each mode. For each mode, the recreation decision was divided into two components: a participation decision (participate or not) and an intensity decision (how often). The mode participation decision was analyzed as a function of individual's demographic and socioeconomic characteristics and the mode intensity decision was evaluated as a function of income, catch, travel costs, and time costs.

To investigate the opportunity cost of time, three questions were included in the angler survey. The first question is "For the typical 1983 saltwater fishing trip, would you have been working if you hadn't gone fishing?" If the answer was "yes", then a second question followed, asking whether they would have received payment for that work time. If the answer was still "yes", they then need to choose a category that best describes the hourly rate they would have been paid if they had been working. The outcome shows that 487 respondents among the 1330 individuals who answered "yes" to the first question did trade off recreation time against income and have a demand function including travel time factor. In this demand function, one-third of the wage rate was used to measure the value of travel time for all respondents who indicated that they would trade off income for fishing. The remaining 63 percent did not trade off time against income and hence the demand function was estimated without a travel cost element. To include all individuals in the second demand function, an alternative method, which is dividing the average wage rate for all individuals by 2,080 hours, was used to calculate the opportunity cost. For the monetary costs, only boat fees and travel expenses were included in the price variable. Information on both round trip travel expenses and miles travelled were collected for specific and representative trips. In order to reduce measurement error, a "constructed" travel expenses variable was computed by regressing reported travel expenses on reported distance for each mode (Travel expense= α+ β*round trip distance).

Compared with the then "conventional" demand function that omitted the travel time variable, the function including travel time provided a quite different estimate of consumer surplus, which indicates that the previous studies that applied conventional demand functions tend to underestimate the consumer surplus.

The consumer surplus of boat owners by mode ranges from $22 per trip for charter/party fishing (less than 1 day) to $74 per trip for private boat fishing, when estimated with the conventional demand model. Estimates of consumer surplus by mode for boat owners using the time demand model range from $ 91 per trip for charter/party boat trips less than 1 day to $ 366 per trip for charter/party boat trips greater than 1 day.

For the CVM, respondents were asked hypothetical questions about their valuation of recreational activities. This survey followed the contingent behavior approach suggested by Hanemann (1985), who argued that more reliable responses are likely to be obtained if individuals are asked hypothetical questions about their behavior rather than their valuation. At the end of each of the modal participation sections of the questionnaire, respondents were asked: "If the cost of (mode) fishing were increased by $10 per trip, would you stop taking party charter boat trips altogether?" If the answer was "no", the respondent was asked: "What if the cost increase was $20 per trip, or $40 per trip or $ 75 per trip, etc.?" Usually four or five questions were repeated in this bidding game approach.

The mean value of consumer surplus estimated using CVM is $58.34 per trip (an upper bound 20% above the maximum cost increase identified assumed for respondents indicating no cut-off price) under party/charter boat mode; for the Rental boat, the mean value is $17.73 per day; for the private boat, the value is $53.15 per day. So obviously, the estimate using CVM is higher than the estimate using TCM for charter/party fishing while for private fishing, estimates using TCM are higher than CVM.

The authors note that, since values derived from the modal demand equations are based on observed behavior, whereas the values from the contingent valuation are based on responses to hypothetical questions, caution should be paid when comparing the estimated consumer surplus under the two different methods. In addition, different statistical techniques and functional forms could also result in different estimate of consumer surplus.

5.4 Meta-Analysis on Comparison between CVM and TCM

A meta-analysis on comparing CVM to revealed preference (RP) estimates was conducted by Carson et al., (1996), which allows for a big-picture view: if there is a strong signal that CVM, as a general valuation approach, substantially under or overestimates quasi-public goods values relative to RP techniques. The original studies included in this sample provide at least one CVM estimate and one RP estimate for essentially the same quasi-public good. Though the goods valued are various, the studies uses were constrained to valuations by consumers and only CVM estimates of WTP were included to represent stated preferences. Additionally, this study included a range of sources, such as thesis, dissertations, conference papers and government reports, to avoid potential bias in relying upon only the published literature. The revealed preference techniques can be separated into five categories, they are single-site travel cost models (TC1), multiple-site travel cost models (TC2), hedonic pricing (HP), averting behavior (AVERT) and the creation of simulated or actual markets for the goods (ACTUAL).

The results show that the sample mean CV/RP ratio is 0.89 for the complete sample, 0.77 and 0.92 separately for trimmed and weighted data set. When regressing the CVM/RP ratios from the trimmed dataset on a set of dummy variables representing the RP technique used, the estimated coefficients suggest that the CVM estimates run about 20 percent lower than the TC1 counterparts, about 30 percent lower than the TC2 counterparts. However, this still cannot conclude that CVM estimates are always smaller than revealed preference estimates since some CVM estimates clearly exceed their revealed preference counterparts and all samples suggest that there is almost 30 percent chance that, for a randomly drawn comparison, the CV/RP ratio will be greater than one.

To sum up, we cannot make a general conclusion simply based on the methods themselves to identify whether they will give a consistent estimate. Many reasons, including the statistical technique, functional forms (or specifications), elicitation technique, etc. will result in different estimates when using different valuation methods. Though conceding that we still cannot make a judgment on which method yields higher estimate and which yields a lower one, these reviews, which specifically focusing on comparison between the recreational fishing values estimated using both methods, have provided illuminations to this study and related studies to a large extent. Many common characteristics are shared by studies with similar outcomes. For studies giving a higher estimate using CVM than using TCM, they did not make an effort to avoid including non-use value as a consideration in their CVM elicitation questions. Additionally, hypothetical bias, which usually happens in studies ignoring the incentive compatibility and consequentiality, appears to be another contributor to higher CVM estimates. In the opposite, some studies who give lower estimate using CVM tend to bias down respondents' true WTP, for instance, elicited WTP for their last fishing trip. Comparably, studies that do not yield significantly different estimates between these two methods tend to avoid the mistakes mentioned above and show preference on more incentive compatible techniques (Carson and Groves, 2007). Furthermore, the use of the referendum format, extensive questionnaires to help respondents have better understandings, etc. are all helpful methods that appears in studies giving consistent estimates, which to a large extent, eliminated respondents misinterpretations and latent bias.

CHAPTER 6

METHODOLOGY

The 1988 New York Statewide Angler Survey data was obtained from a statewide mail survey of anglers implemented in January 1989 by the Cornell Institute for Social and Economic Research (CISER). Respondents were requested to recall their fishing activities over the one year period in calendar year 1988. This was the third statewide survey of resident and nonresident fishing experiences after two such surveys in 1973 (Brown 1975) and 1976-77 (Kretser and Klatt 1981). Two subsequent statewide surveys were conducted in 1996 and 2007. The mail survey was completed in a way that allows the exploration of fishing value employing Contingent Valuation Method (CVM) and the Travel Cost Method (TCM) simultaneously, thus making comparisons between these two methods become available. A nested-logit discrete choice model was used when employing the TCM and the welfare estimates under CVM method is calculated based on the method stated in Chapter 3.

6.1 Travel Cost Method

6.1.1 Logit Model

6.1.1-1 Standard Logit Model

Under the assumption that each unobserved portion of utility ε_{nj} is independently, identically distributed extreme value, which is also called Gumbel and type I extreme value, the density for each unobserved component of utility is

$$f\left(\varepsilon_{nj}\right) = e^{-\varepsilon_{nj}} * e^{-e^{\varepsilon_{nj}}} \qquad 6.1.1\text{-}1\ (1)$$

and the cumulative distribution is

$$F\left(\varepsilon_{nj}\right) = e^{-e^{-\varepsilon_{nj}}} \qquad 6.1.1\text{-}1\ (2)$$

If we denote $\varepsilon^{*}_{nji} = \varepsilon_{nj} - \varepsilon_{ni}$, the extreme value ε^{*}_{nji} is distributed logistic and has a mean of zero. Then the cumulative distribution is

$$F\left(\ \varepsilon^{*}_{nji}\right) = \frac{e^{\varepsilon^{*}_{nji}}}{1 + e^{\varepsilon^{*}_{nji}}} \qquad 6.1.1\text{-}1\ (3)$$

So the probability that decision maker n chooses alternative i is

$$\begin{aligned} P_{ni} &= Prob\left(U_{ni} > U_{nj}\right) \qquad 6.1.1\text{-}1\ (4) \\ &= Prob(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}\ \forall i \neq j) \\ &= Prob(\varepsilon_{nj} < \varepsilon_{ni} + V_{ni} - V_{nj}\ \forall i \neq j) \end{aligned}$$

$$P_{ni} = e^{-e^{-(\varepsilon_{ni}+V_{ni}-V_{nj})}} \qquad 6.1.1\text{-}1\ (5)$$

Since the $\varepsilon's$ are independent, this cumulative distribution over all $j \neq i$ is the product of the individual cumulative distributions:

$$P_{ni}|\varepsilon_{ni} = \prod_{j \neq i} e^{-e^{-(\varepsilon_{ni}+V_{ni}-V_{nj})}} \qquad 6.1.1\text{-}1\ (6)$$

Since ε_{ni} is not given, the choice probability is the integral of $P_{ni}|\varepsilon_{ni}$ over all values of ε_{ni} weighted by its density with the expression:

$$P_{ni} = \int (\prod_{j \neq i} e^{-e^{-(\varepsilon_{ni}+V_{ni}-V_{nj})}}) * e^{-\varepsilon_{ni}} * e^{-e^{\varepsilon_{ni}}} \, d\varepsilon_{ni} \qquad 6.1.1\text{-}1\ (7)$$

From this, the following simplified closed form of logit choice probability can be derived as:

$$P_{ni} = \frac{e^{V_{ni}}}{\sum_j e^{V_{nj}}} \qquad 6.1.1\text{-}1\ (8)$$

Representative utility is usually specified to be linear in parameters: $V_{nj} = \beta' x_{nj}$, where x_{nj} is a vector of observed variables relating to alternative j. With this specification, the logit probability becomes

$$P_{ni} = \frac{e^{\beta' x_{ni}}}{\sum_j e^{\beta' x_{nj}}} \qquad 6.1.1\text{-}1\ (9)$$

which represents the probability that individual n chooses i from j alternatives. McFadden (1974) demonstrated that the log-likelihood function with these choice probabilities is globally concave in parameters β, which helps in the numerical maximization.

Advantages of the standard logit model include its simple close-form solution and ease of numerical maximization. In addition, it also enjoys several desirable properties. First, P_{ni} is necessarily between zero and one. Second, the choice properties for all alternatives sum to one:

$$\sum_{i=1}^{J} P_{nj} = \sum\nolimits_i \exp(V_{ni}) \Big/ \sum\nolimits_j \exp(V_{nj}) = 1 \qquad 6.1.1\text{-}1\ (10)$$

However, there are limitations when applying the logit model. First, the logit model as specified cannot represent random taste variation-the differences in tastes that cannot be linked to observed characteristics. To incorporate random taste variation appropriately and fully, a probit or mixed logit model can be used instead.

Second, the logit model implies proportional substitution across alternatives, given the researcher's specification of representative utility. To capture more flexible forms of substitution, other models are needed. The logit model exhibits the property "independence from irrelevant alternatives", or called IIA, which means for any two alternatives $i \text{ and } k$, the ratio of the logit probability does not depend on any alternatives other than $i \text{ and } k$. A pattern of substitution, called "proportionate shifting", is a manifestation of the IIA property. That is, an improvement in the attributes of an alternative reduces the probabilities for all the other alternatives by the same percentage and for a decrease in the representative utility of an alternative, the probabilities for all other alternatives rise by the same percentage. While the IIA property is realistic in some choice situations, it is clearly inappropriate in others. So relaxing the IIA assumption and providing more flexible specifications, like nested logit and mixed logit models, has become a focus of econometric modeling in recent decades. As such, the simple model with IIA is a special case that arises under certain constraints on the parameters of the more flexible model.

6.1.1-2 Nested Logit Model

A nested logit model is appropriate when the set of alternatives faced by a decision maker can be partitioned into subsets, called nests, in such a way that the IIA holds within each nest while IIA restriction is not imposed for alternatives in different nests. For any two alternatives in different nests, the ratio of probabilities can depend on the attributes of other alternatives in the two nests.

A tree diagram is a convenient way to picture the substitution patterns, in which each branch denotes a subset of alternatives within the IIA holds, and every leaf on each branch denotes an alternative. An example cited from Train's book (2009) on worker's choice of travel mode is represented in Figure 4-1, which is one of the appropriate cases illustrating the conditions hold for substitution patterns in nested logit models.

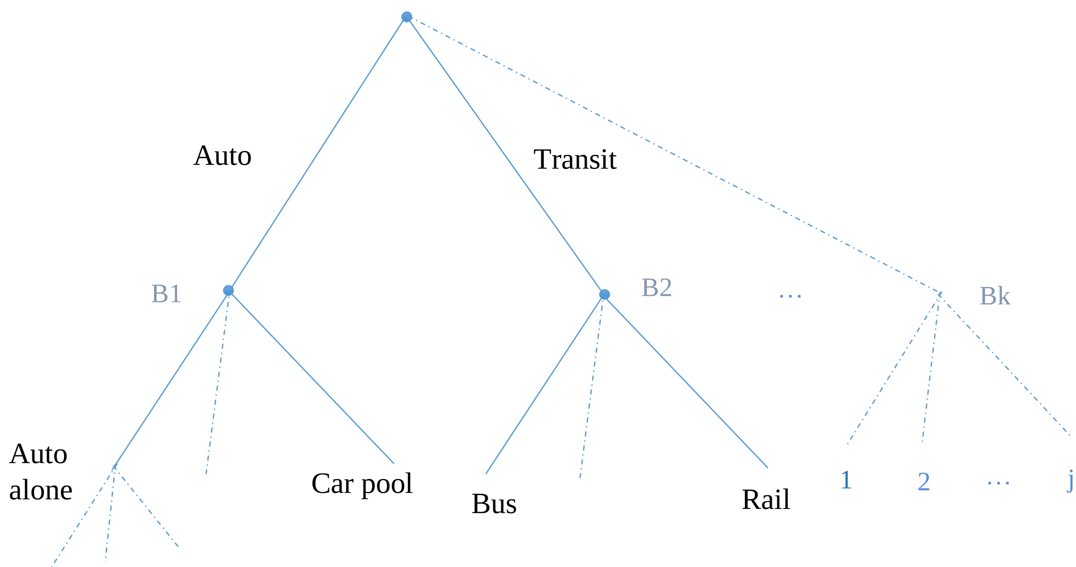

Figure 2: Generalized Nested Logit Model

Following this representation, the utility that person n obtains from alternative j in nest B_k is denoted, as usual, as

$$U_{nj} = V_{nj} + \varepsilon_{nj} \qquad 6.1.1\text{-}2\ (1)$$

In the above equation, V_{nj} is the observed portion of utility and ε_{nj} is a random variable whose value is not observed by researcher. The nested logit is obtained by assuming that the vector of unobserved utility ε_n has cumulative distribution:

$$\exp(-\sum_{k=1}^{K}(\sum_{j\epsilon B_k} e^{-\varepsilon_{nj}/\lambda_k})^{\lambda_k}) \qquad 6.1.1\text{-}2\ (2)$$

where $\varepsilon_{nj}'s$ are correlated within nests, but still uncorrelated in different nests. The parameter λ_k is a measure of the degree of independence in unobserved utility among the alternatives in nest k. A higher value of λ_k means greater independence and less correlation and a value $\lambda_k = 1$ indicates complete independence within nest k, that is, no correlation. Then the choice probability for people n choose alternative j is:

$$P_{ni} = \frac{e^{V_{ni}/\lambda_k}(\sum_{j\epsilon B_k} e^{V_{nj}/\lambda_k})^{\lambda_k - 1}}{\sum_{l=1}^{K}(\sum_{j\epsilon B_l} e^{V_{nj}/\lambda_l})^{\lambda_l}} \qquad 6.1.1\text{-}2\ (3)$$

If the value λ_k is within zero and one, the model is consistent with utility maximizing behavior for all possible values of the explanatory variables. For λ_k greater than one, the model is consistent with utility-maximizing behavior for some range of the explanatory variables but not for all values. A negative value of λ_k is inconsistent with utility maximization and implies that improving the attributes of an alternative can decrease the probability of the alternative being chosen.

To make the choice probabilities simple and readily interpretable, we can decompose the utility components into two parts, and the utility can be rewritten as:

$$U_{nj} = W_{nk} + Y_{nj} + \varepsilon_{nj}, j\epsilon B_k \qquad 6.1.1\text{-}2\ (4)$$

Where, W_{nk} depends on variables that describe nest k. These variables differ over nests but not over alternatives within each nest. Y_{nj} depends on variables that describe alternative j. These variables vary over alternatives within nest k.

With this decomposition of utility, the nested logit probability can be written as the product of two standard logit probabilities. Then the probability that an alternative i within nest k is chosen can be expressed by:

$$P_{ni} = P_{ni|B_k} * P_{nB_k} \qquad 6.1.1\text{-}2\ (5)$$

where $P_{ni|B_k}$ is the conditional probability of choosing alternative i given that an alternative in nest B_k is chosen, and P_{nB_k} is the marginal probability of choosing an alternative in nest B_k. In particular, the marginal and conditional probability can be expressed as:

$$P_{nB_k} = \frac{e^{W_{nk}+\lambda_k I_{nk}}}{\sum_{l=1}^{K} e^{W_{nl}+\lambda_l I_{nl}}} \qquad 6.1.1\text{-}2\ (6)$$

$$P_{ni|B_k} = \frac{e^{Y_{ni}/\lambda_k}}{\sum_{j\epsilon B_k} e^{Y_{nj}/\lambda_k}} \qquad 6.1.1\text{-}2\ (7)$$

Where

$$I_{nk} = ln \sum_{j\epsilon B_k} e^{Y_{nj}/\lambda_k} \qquad 6.1.1\text{-}2\ (8)$$

It is customary to refer to the marginal probability (6.1.1-2(6)) as the upper model and to the conditional probability (6.1.1-2(7)) as the lower model reflecting their relative positions. I_{nk} is often called the inclusive value or inclusive utility of nest B_k, which is actually the log of the denominator of the lower model. The quantity I_{nk} links the upper and lower model by bringing information from the lower model into the upper model and $\lambda_k I_{nk}$is the expected utility that decision maker n receives from the choice among the alternatives in nest B_k. (Train 2011)

The traditional maximum-likelihood procedure is applied here for estimation. The probability of person n choosing alternative i can be expressed as:

$$\prod_i (P_{ni})^{y_{ni}} \qquad \text{6.1.1-2 (9)}$$

where $y_{ni} = 1$ if person n choose i, and zero otherwise. Assuming that each decision maker's choice is independent of what of other decision makers, the probability of each person in the sample choosing the alternative that he was observed actually to choose is

$$L(\beta) = \prod_{n=1}^{N} \prod_i (P_{ni})^{y_{ni}} \qquad \text{6.1.1-2 (10)}$$

where β is a vector containing the parameters of the model. The log-likelihood function is therefore

$$LL(\beta) = \sum_{n=1}^{N} \sum_i y_{ni} lnP_{ni} \qquad \text{6.1.1-2 (11)}$$

The estimator is the value of β that maximizes this function. At the maximum, its derivative with respect to each of the parameters is zero

$$\frac{dLL(\beta)}{d\beta} = 0 \qquad \text{6.1.1-2 (12)}$$

To make the discussion more succinct, let the representative utility be linear in parameters:

$$V_{nj} = \beta' x_{nj} \qquad \text{6.1.1-2 (13)}$$

Then the first order condition becomes

$$\sum_{n}\sum_{i}(y_{ni} - P_{ni})x_{ni} = 0 \qquad 6.1.1\text{-}2\ (14)$$

6.1.2 Choice Set

The choice set includes all the sites where anglers can go fishing in New York State. Though theoretically every water body can be regarded as a part of individual's choice set since people can visit any available site in the state, I aggregated all these possible lakes, rivers and streams by county in our model for a more convenient analysis without large deviation. For each site, respondents were asked explicitly about the county or nearest post office that the water body lies. The County Code generated was based on the county name or post office indicated. Self-reported miles, which is the one-way distance that respondents travel from their home to destination, were elicited in the survey. While this may be a more accurate approximation of distances traveled, it was not used in the model because consistent information on the distance to alternative sites in people's choice set was needed as well. Instead, the PC*Miler[1] calculated distance from origin to all possible destinations is used, along the lines of what Loomis refers to as the standard model. The origin and destination are the zip code of the angler's address and the centroid of the county in which the fishing site is located. For the GL counties, the approximate center of the GL shoreline was used as the destination point. (See Figure 6-1). In addition, travel time and toll cost which are unavailable from NYSDEC survey, were all calculated by PC*Miller.

There are seventy-one destinations in the choice set in total. Since among the 62 counties in New York State, nine of them are the borders of the Great Lakes[2], anglers who indicating they

[1] PC*Miler: a truck routing, mileage and mapping software for the transportation and logistics industry.
[2] The 9 counties are: Chautauqua, Erie, Niagara, Orleans, Monroe, Wayne, Cayuga, Oswego, and Jefferson.

went fishing in Great Lakes (GL) in these nine counties were separated from those who go Inland Lakes (IL) fishing in the same counties. For instance, people go GL fishing in county Erie is of different destination from people who go IL fishing in county Erie. In addition, the counties that people spent more than 180 minutes to travel to were excluded from their choice set since they are highly skeptical of being destinations that people travel to fish for a single day. So multipurpose trips and multiple day trips can be eliminated under this way.

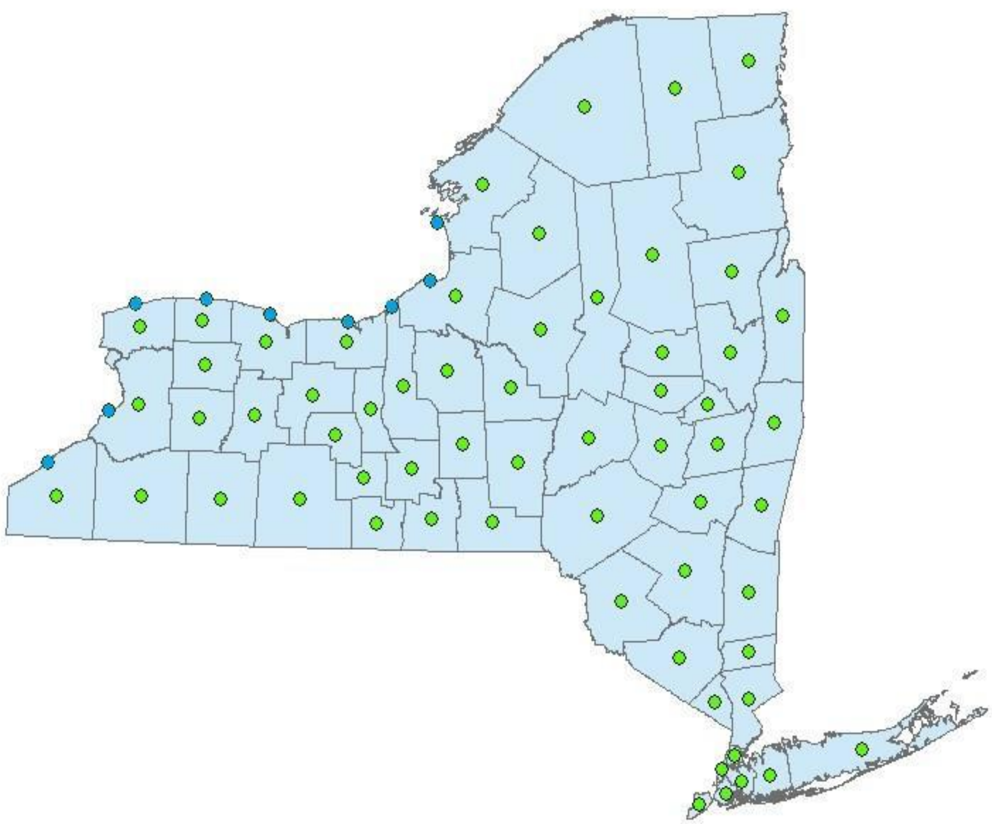

Figure 3: Approximate Destination Points (Source: Spink 2014)

6.1.3 Travel Cost Components and Calculation

The travel cost consists of three parts: distance cost, opportunity cost of time and toll cost. Distance cost is calculated by multiplying round trip travel distance by the cost per mile. From the statistical data of United States Department of Transportation, the cost per mile of operating a vehicle in 1988 was 29.08 cents, including gas, maintenance, insurance, tire, financing, license registration, and vehicle depreciation costs. The opportunity cost per hour is represented by one third of respondents' wage rate. The hourly wage rate is estimated by using respondents' reported annual income divide by 2000, an estimation of working hours per year. After multiplying by the round trip travel time (in hours) we can get the opportunity cost for people traveling from the center of the origin county identified by zip code to the center of the destination county identified by the county code. Since its impossible for us to calculate 1988 toll costs using PC*Miler, I use the adjusted toll cost, which using the 2007 toll cost multiply by an adjustent ratio, which equals 1988 average toll cost over 2007 average toll cost for New York State, to serve as the toll cost for certain trips in 1998 (JOCOBS 2012). The aggregation of these three components make the approximate travel cost we use for estimation.

$$Travel\ Cost = Distance\ Cost + Opportunity\ Cost + Toll\ Cost\ 1988$$

$*Distance\ Cost = Cost\ Per\ Mile * Round\ Trip\ Distance\ (in\ miles)$

$*Opportunity\ Cost = \frac{1}{3} * Wage\ Per\ Hour * Round\ Trip\ Time\ (in\ hours)$

$*Toll\ Cost\ 1988 = Round\ Trip\ Toll\ Cost\ 2007 * Adjustment\ Ratio$

$*Adjustment\ Ratio = (1988\ Average\ Toll\ Cost)/(2007\ Average\ Toll\ Cost)$

6.1.4 Data

A systematic sample of 17,000 licenses was selected for the license year beginning October 1, 1987 and ending September 30, 1988. All licenses that permitted either resident or nonresident fishing formed the population from which the sample was drawn. The licenses were selected at three times during the course of the year to facilitate data entry of names and addresses, which were sorted by county of purchase and selected on a county-by-county basis. Up to three follow-up mailings were sent to non-respondents over the course of the following month. Of the 16,998 questionnaires mailed, 468 were undeliverable and 10,314 completed questionnaires were returned, which resulted in an adjusted response rate of 62.4%.

This study is mainly based on the survey data that has been cleaned by the original data collectors though reshaping the format and excluding some nonsense responses. This “cleaned” data set includes 23,032 observations coming from 8,750 identified anglers (Connelly and Brown 1990). Numerous missing observations concerning some main variables exist in the survey. All of the data for an angler had to be dropped if there were missing values pertaining to the demographics of the angler, such as gender, age, income, and education years. This results in 94 cases of missing values for the gender, 94 cases of missing values for the age, 1,618 cases of missing values for the self-reported income, 1,096 cases of unknown[1] income and 442 cases of missing values for the education years. An additional 1,554 anglers (or 2856 cases) who are non-residence of the New York state were excluded from the analysis. So 2,532 anglers in total were excluded from the data set.

[1] Unknown income: many reasons result in people’s self-reported income is unclear, represented by “99” instead of exact annual income in the data set “effort3”, provided by Nancy Connelly.

In cases where there were missing values pertaining to the county that people visited, that destination was excluded from the analysis, however the total trips made by the angler was calculated before dropping destinations with missing values. Therefore, in cases in which the destination is unknown, it is still known how many trips that the angler made in total over the survey period. There were 2,081cases of missing destination county values in the survey and 375 cases of unknown destination[1]. So 867 anglers in total were dropped.

The remainder of the data that is excluded from the analysis is due to nonsensical survey results. Cases in which the angler claimed to have spent more days fishing in total than there were days in the survey period were dropped from the analysis (i.e. days>365). There were also several cases of survey respondents filling out a water body that they traveled to during the survey period but then claimed to have spent zero days at that destination. In addition, cases in which the angler claimed to have traveled to a Great Lake, but not to one of the nine counties that border the Great Lakes, were dropped from the analysis. Furthermore, the destinations which are not in people's choice set, greater than three hours away from their zip code of residence for instance, were excluded from the site choice data, while the total days that angler spent fishing still would not change. At last, anglers who reported their age under 16 were dropped from the data set.

6.1.5 Variables

The variables used in this study can be separated into three groups: demographic variables describing the angler $X_n(the\ demographic\ variables\ of\ people\ n, n =$

[1] Unknown destinations: reported destination county is unclear, represented by "888" instead of county code in the data set "effort3", provided by Nancy Connelly.

$1,2 \ldots N, N = total\ number\ of anglers$); nest variable describing the characteristics of GL fishing W_k ($W_k = 1\ if\ people\ go\ fishing\ in\ GL\ county; otherwise, W_k = 0$); and variables describing people n's choice with respect to site j, which is represented by $Y_{nj}, j = 1,2 \ldots J, J = site\ size$.

More specifically, demographic variables include:

Age: calculated from the "date of birth" of NYSDEC survey data at the end of 1988

Gender: dummy variable generated from NYSDEC survey data, Female=1

Income: derived from people's self-report annual income in NYSDEC survey data.

Education Level: dummy variable generated from NYSDEC survey data,

$$Education \begin{cases} = 1, if\ edyr \geq 16\ (college\ level) \\ = 0, otherwise \end{cases}$$

Table 4: Description of Demographic Variables

Variable	N	Mean	Std.Dev.	Min	Max
Reported Income ($ 000)	5333	34.42	16.67	1	80
Average Income for zip code ($ 000)	5332	27.45	16.00	9.14	283.33
Difference between Income and Average Income ($ 000)	5332	6.98	20.95	258.16	65.66
Age	5333	40.86	14.23	16	88
Number of fishing destinations	5333	2.56	1.72	1	8
Gender (Female=1)	5333	0.16	0.37	0	1
Education Level (edyrs >15)	5333	0.24	0.43	0	1

The only variable defining the choice of going GL or IL water fishing is a dummy variable W_k , which equals 1 when people go GL fishing.

Variables that describe the fishing sites include:

* *Total stream length per county*: from NYSDEC streams file. (Spink 2014)
* *Total lake area per county*: from NYSDEC lakes file. (Spink 2014)
* *Total shore length per county*: from NYSDEC lakes file (Spink, 2014)
* *Total Great Lake shoreline per county*: from Ready et al. (2012)

The data concerning these variables are collected after 2010 from NYSDEC website. By assuming a comparably stable condition of these sites' characteristics through twenty years, which is to some extent reasonable, I apply them in this study to elicit site characteristic effects. Specifically, the total stream length per county was generated from a shape file of approximately 56,000 rivers and streams in New York State from the NYSDEC; The length of all streams per county was calculated using an overlay operation; The resulting rivers and river segments were summed per county; The total lake area per county and the total shore length per county were similarly calculated from a shape file of approximately 30,000 lakes and ponds in New York from the NYSDEC (Spink 2014). Alternatively, the Great Lakes shoreline variable was obtained from the authors of Ready et al. (2012), and the values for lake area and lake perimeter do not include Great Lakes area and shoreline.

Additionally, the travel cost, which is calculated from the center of origin zip code to the center of Destination County for each trip, is one of the main variables that we expect to be highly correlated to their site choice.

Table 5: Description of County Water Body Characteristics

Variable	N	Mean	Std. Dev.	Min	Max
Inland Lake Stream Length (mi)	62	1,352.32	938.4	0.17	5,658.27
Inland Lake Surface Area (Sq. mi)	62	15.7	18.79	0.08	73.21
Inland Lake Shore Length (mi)	62	204.68	226.68	4.21	1,015.98
Great Lake Shore Length (mi)	9	31.43	10.64	8.09	46.14

Table 6: Description of Travel Cost and Components

Variable	N	Mean	Std. Dev.	Min	Max
Travel Cost ($)	13,614	35.65	32.64	0.23	206.69
Drive Time (minutes, calculated)	13,614	51.08	40.41	0	180
Distance (miles, calculated)	13,614	43.13	38.53	0.4	185.2
Distance (miles, self-report)	13,569	36.61	42.95	0	500
Difference between Calculated and Self-Reported distances (miles)	13,569	6.44	26.77	470.5	179
Great Lake Destination (%)	13,614	12.81	34.23	0	1

6.1.6 Choice Probability

Extending previous sections, the general form of the tree diagram in Figure 2 can be specified into a three level nested logit diagram that applies in this study appropriately.

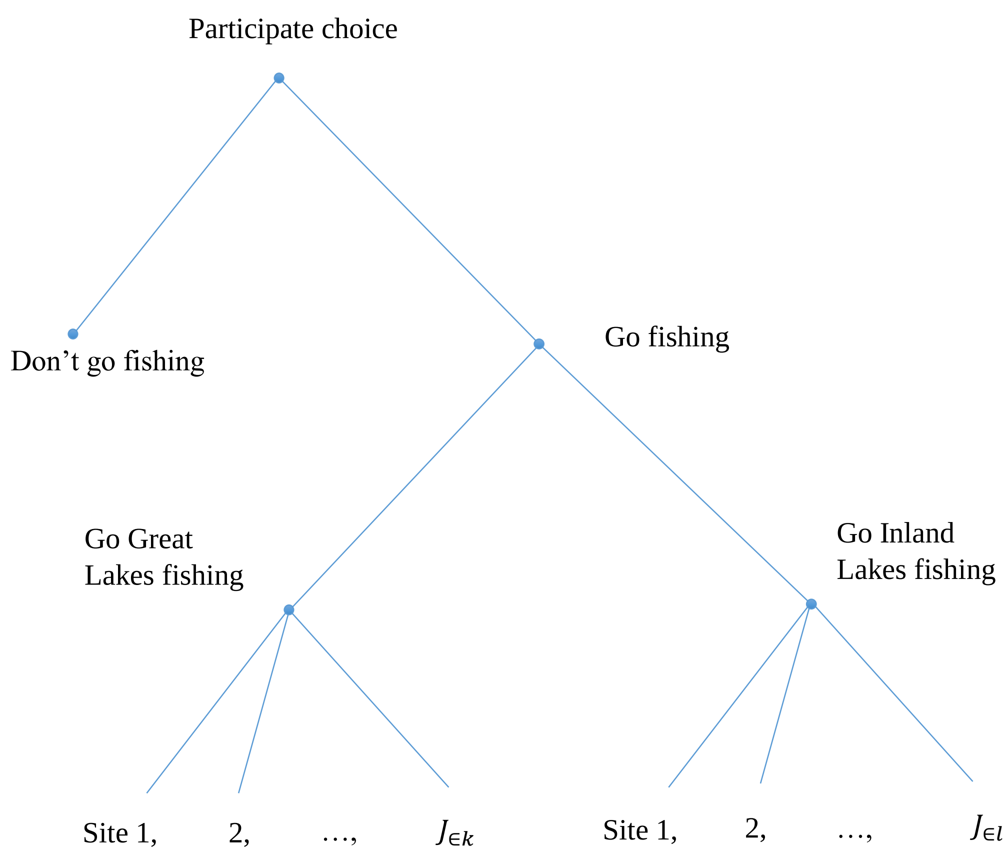

Figure 4: Three Level Nested Logit Model

The utility function for angler n go to site j is:

$$U_{nj} = X_n + W_k + Y_{nj} + \varepsilon_{nj} \qquad (6.1.6\text{-}1)$$

where X_n include demographic variables that describes the characteristics of the angler n, W_k is the dummy variable describing the choice of go Inland Lakes fishing or Great Lakes fishing, and Y_{nj} is the portion of utility that describes the choice of fishing site within the nest.

The probability of angler n going to site j can be expressed as:

$$P_{ni} = P_{np} * P_{nk|p} * P_{ni|k,p} \qquad (6.1.6\text{-}2)$$

where

$$P_{ni|k,p} = \frac{e^{Y_{ni}/\lambda_k}}{\sum_{j\in k} e^{Y_{nj}/\lambda_k}} \qquad (6.1.6\text{-}3)$$

which is the probability of angler n going to site i, conditional on site i belongs to nest k and anger choose go fishing in nest k. As discussed previously, λ_k is known as the scale parameter, which represents the degree of independence between the unobserved portions of utility within the nest k. Similarly, λ_l represent the degree of independence between the unobserved portions of utility within the nest l. For consistency, this study will use k denotes Great Lakes fishing nest and l denotes Inland Lakes fishing nest throughout the analysis. So without loss of generality, the probability functions stated in (6.1.6-3) just represent the case that people visit fishing sites among Great Lakes fishing nest, but in cases where people go Inland-Lakes fishing, we should replace k by l. Since there is no reason to restrict the degree of independence within each nest to be the same, two different scale parameters λ_k *and* λ_l are allowed here.

The inclusive value for Great Lakes fishing is:

$$I_{nk} = \ln\left(\sum_{j\in k} e^{Y_{nj}/\lambda_k}\right) \qquad (6.1.6\text{-}4)$$

which equals the natural log of the denominator of the conditional site choice probability. Multipling this inclusive value by the scale parameter belonging to respective nests, (e.g. $\lambda_k * I_{nk}$ for Great Lakes fishing) represent the maximum expected utility of the alternatives in the nest. The inclusive value brings the information from the site choice probability to the fishing type (GL or IL fishing) probability.

The probability of going Great Lakes fishing conditional on angler participate in fishing can be expressed by:

$$P_{nk|p} = \frac{e^{(W_k+\lambda_k * I_{nk})/\sigma}}{e^{(W_k+\lambda_k * I_{nk})/\sigma} + e^{(W_k+\lambda_l * I_{nl})/\sigma}} \qquad (6.1.6\text{-}5)$$

where, σ is the scale parameter for fishing type which indicates the degree of independence between the two nests (or two fishing types). We can recall that W_k is the portion of utility that represent the identical characteristics of each nest, and equals one if people go Great Lakes fishing, or else equals zero.

The inclusive value for participation is:

$$I_{np} = \ln(e^{(W_k+\lambda_k * I_{nk})/\sigma} + e^{(W_k+\lambda_l * I_{nl})/\sigma}) \qquad (6.1.6\text{-}6)$$

which, when multiplied by σ, represents the maximum expected utility of participating in fishing. The inclusive value for participation brings information from site choice probability and fishing type choice probability to participation probability, given by

$$P_{np} = \frac{e^{(X_n+\sigma * I_{np})/\rho}}{1 + e^{(X_n+\sigma * I_{np})/\rho}} \qquad (6.1.6\text{-}7)$$

where, ρ is the scale parameter represents the degree of independence between the decision to participate in fishing or not. Besides, the utility function of the choice, not go fishing, is normalized to zero, which gives e^0(=1) in the denominator. Since ρ is the scale parameter lies at the top nest, it is normalized to 1, following Ben-Akiva and Lerman (1985). Then the probability can be expressed as

$$P_{np} = \frac{e^{(X_n + \sigma * I_{np})}}{1 + e^{(X_n + \sigma * I_{np})}} \qquad (6.1.6\text{-}8)$$

Similarly, the natural log of the denominator expresses the inclusive value when people facing participation choices, go fishing or not, and the maximum expected utility of this occasion regardless of whether angler goes fishing or not can be deduced by multiplying scale parameter ρ, which has been normalized to 1.

$$EU_n = \ln(1 + e^{(X_n + \sigma * I_{np})}) \qquad (6.1.6\text{-}9)$$

However, considering the circumstances that many anglers live so far away from the Great Lakes area that water bodies belongs to Great Lakes are not included in their choice set, I use a partially degenerate branch under this case (Hensher et al, 2005).

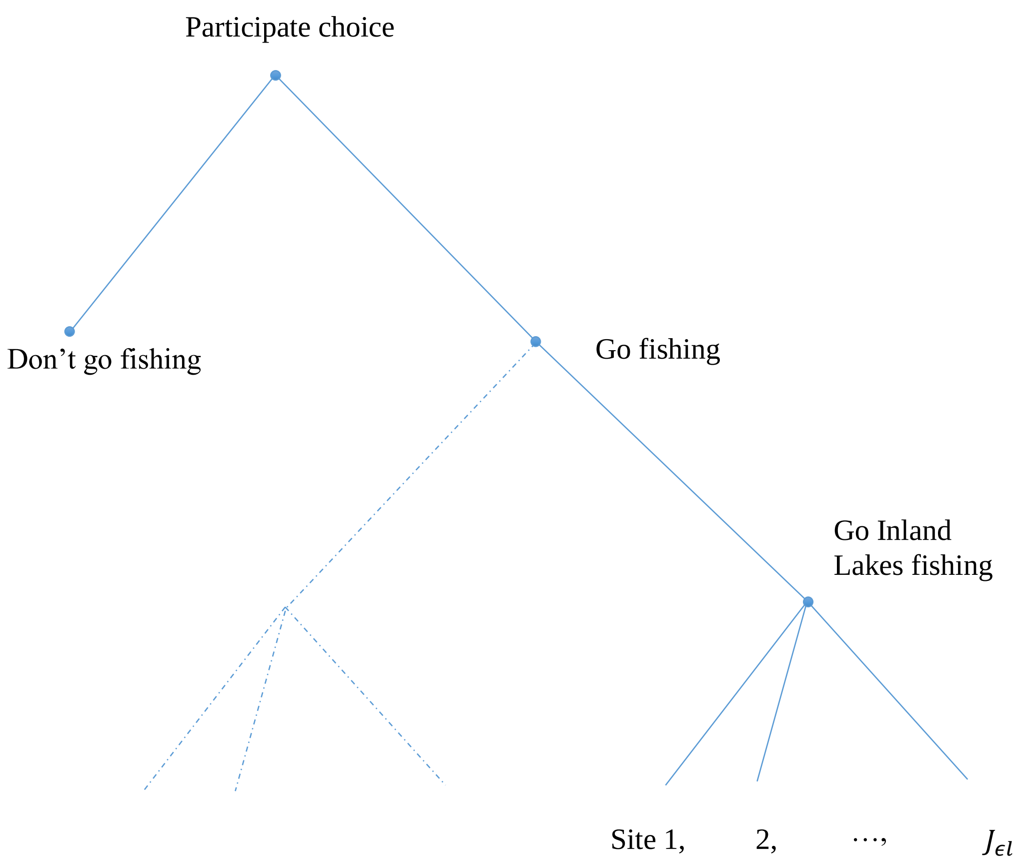

Figure 5: Two Level Nested Logit Model

In this degenerate model, the site choice probability, which is the probability that angler n go fishing on site j ($j\epsilon l$ when people do not have GL in their choice set) is the same as equation (6.1.6-3), except for changing fishing type from Great Lakes fishing to Inland Lakes fishing, is expressed by

$$P_{ni|l,p} = \frac{e^{Y_{ni}/\lambda_l}}{\sum_{j\in l} e^{Y_{nj}/\lambda_l}} \tag{6.1.6-10}$$

The inclusive value for people go Inland Lakes fishing is

$$I_{nl} = \ln(\sum_{j\in l} e^{Y_{nj}/\lambda_l}) \tag{6.1.6-11}$$

The probability that an angler goes fishing in Inland Lakes conditional on angler participate in fishing can be expressed by

$$P_{nl|p} = \frac{e^{\lambda_l * I_{nl}/\sigma}}{e^{\lambda_l * I_{nl}/\sigma}} = 1 \qquad (6.1.6\text{-}12)$$

which is exactly the same equation as (6.1.5-5) , when $e^{(W_k+\lambda_k * I_{nk})/\sigma}$ equals 0 and W_k, the portion of utility representing the nest which does not exist under this circumstances, is normalized to 0.

The inclusive value for people participating in fishing is:

$$I_{np} = \ln(e^{\lambda_l * I_{nl}/\sigma}) \qquad (6.1.6\text{-}13)$$

The probability for people participating in fishing is also the same with equation (6.1.6-8), after changing k to l, which is

$$P_{np} = \frac{e^{(X_n+\sigma * I_{np})}}{1 + e^{(X_n+\sigma * I_{np})}} \qquad (6.1.6\text{-}14)$$

In fact, when inspecting the components of probability function P_{ni}, we can find the two approaches above are exactly the same, which has further proved the validity of the two-level nest model is just one special case of the general nested logit model.

$$P_{ni} = P_{ni|l,p} * P_{nl|p} * P_{np} = \frac{e^{Y_{nl}/\lambda_l}}{\sum_{j\in l} e^{Y_{nj}/\lambda_l}} * \frac{e^{X_n+\lambda_l * \ln(\sum_{j\in l} e^{Y_{nj}/\lambda_l})}}{1 + e^{X_n+\lambda_l * \ln(\sum_{j\in l} e^{Y_{nj}/\lambda_l})}} \qquad (6.1.6\text{-}15)$$

6.1.7 Estimation

The maximum log likelihood function can be expressed as:

$$LL(\beta) = T'_{ni} * \ln(P_{ni}) + \left(366 - T_{np}\right)' * \ln(1 - P_{np}) \qquad (6.1.7\text{-}1)$$

where

* P_{ni} is the vector of choice probability of angler n go fishing at site i

* P_{np} is the vector of participation probability of angler n participating in fishing activity

* T_{ni} is the vector of number of trips made by angler n go fishing at site i

* T_{np} is the vector of number of total trips made by angler n during the survey period

Since there were 366 days in year 1988, "366" is used here to represent the maximum number of trips that an angler can take though the year. Since the maximum log-likelihood function is not globally concave under the nested logit discrete choice model, the starting points we pick for iteration will greatly influence the estimation outcome. One applicable method to solve this problem is to use multiple starting points, and pick the estimates providing largest the maximum log-likelihood value when iteration ends, then the coefficients we get are ensured to be the consistent and most efficient ones. Constraining the estimators to theoretical reasonable range can speed up the iteration procedure.

6.1.8 Welfare Calculation

According to Ready et al. (2012), an approximate recreational fishing value per angler day can be estimated from the parameters of the nested logit model by dividing the participation nest parameter by the coefficient of the travel cost variable

$$value\ per\ day = \frac{\sigma}{-\beta_{tc}} \tag{6.1.8-1}$$

when multiplied by the number of anger days in 1988 provides an estimate of the recreational fishing value in year 1988. The angler days in 1988 was estimated by Connelly and Brown as 20,767,000 days.

The logit model is often used to measure welfare effects of changes in site quality. The change in utility per choice occasion in equation (6.1.8-2) is used to estimate the level of compensating variation, the amount that an angler would need to be compensated to return to their previous of utility. The change in expected utility is divided by the coefficient on travel cost which is the marginal utility of income and multiplied by the number of choice occasions, which here is 366, during the survey period.

$$CV_n = \#choice\ occasions * \frac{(EU_n^0 - EU_n^1)}{-\beta_{tc}} \tag{6.1.8-2}$$

where EU_n^0 is the expected utility per choice occasion per angler before the change in quality or site availability and EU_n^1 is the expected utility per choice occasion per angler after the change.

The closures of fishing sites were simulated to generate changes in welfare estimates following equation (6.1.6-3). Since the lowest unit of site aggregation is the county level, the closure of the entire county of Oswego was simulated. This county was chosen because it offers both inland water and Great Lake fishing and is in most anglers' choice sets. Although this is an unrealistic example, it could represent an environmental disaster such as a chemical spill or acidification of fisheries that renders this county unsuitable for fishing. Simulating this change using the optimal parameter estimates involved two components. First, the choice of inland water fishing and Great Lake fishing in the county was removed from the choice set of all anglers who would have the option to travel the Oswego County. Secondly, those anglers who chose to fish in Oswego County were forced to choose the option that gives them the next highest utility. The expected utility per choice occasions after the change is subtracted from the expected utility before the change to generate the per angler difference in expected utility. This value is then divided by $-\beta_{tc}$ and multiplied by the number of choice occasions (366 days in a year) to generate a yearly loss of welfare. For simplicity, the mean of the change in consumer surplus was taken over all anglers in the sample and multiplied by the number of anglers in New York in 1988. It is important to note that this method assumes that the same number of fishing trips is taken before and after the change. In reality, we would expect that some anglers who traveled to Oswego County would have chosen not to go fishing instead of substitute to another county.

To calculate the confidence intervals for the value per day estimates and the value per year estimates, the delta method is used here. The variance function can be expressed as:

$$variance = \sigma_{ii} g_i'^2 + \sigma_{jj} g_j'^2 + 2\sigma_{ij} g_i'^2 g_j'^2 \qquad (6.1.8\text{-}3)$$

where $\sigma_{ii}$is the variance of estimate i, g_i' is the derivative of the function with respect to estimate i, and σ_{ij} is the covariance of estimate i and estimate j.

So the variance of value per day estimated by $\frac{\sigma}{-\beta}$ can be expressed as:

$$var(value\ per\ day) = \frac{1}{\beta^2}var(\sigma) + \frac{\sigma^2}{\beta^4}var(\beta) - 2\frac{\sigma}{\beta^3}cov(\sigma,\beta) \qquad (6.1.8\text{-}4)$$

The variance of the value per year estimate is expressed as:

$$var(value\ per\ year) = \theta^2 var(\eta) + \eta^2 var(\theta) - 2\theta\eta cov(\eta,\theta) \qquad (6.1.8\text{-}5)$$

where θ denotes the value per day and η denote the number of days fished in 1988. The fishing days in 1988 was estimated by Connelly and Brown (1991) in adjusted and unadjusted forms. Since calculating the adjusted variance of the total angler days is unavailable now, I use the unadjusted angler days and it's variance in calculation here. Since, I do not know the variance of θ and η, the bounds of variance can be found using the fact that the correlation between these two variables is between -1 and 1.the correlation between the two estimates is given by

$$-1 < \rho = \frac{cov(\eta,\theta)}{\sigma_\eta \sigma_\theta} < 1 \qquad (6.1.8\text{-}6)$$

Then the ranges of the covariance is

$$-\sigma_\eta\sigma_\theta < cov(\eta,\theta) < \sigma_\eta\sigma_\theta \qquad (6.1.8\text{-}7)$$

Therefore,

$$var(value\ per\ year) \leq \theta^2 var(\eta) + \eta^2 var(\theta) + \sigma_\eta\sigma_\theta \qquad (6.1.8\text{-}8)$$

Using the maximum variance of the value per year, we can get an estimate of the variance.

6.2 Contingent Valuation Method

6.2.1 Data

Among the systematic sample of 17,000 residents and non-residents, only half of them were asked to answer the questionnaire that include WTP questions. Respondents were asked to list the number of days fished, species sought, and on-site and en route expenditures by location fished for year 1988, followed by the WTP section of questionnaire. In the WTP section, respondents were asked to recall a specific fishing trip to the second location they listed in the previous section of the questionnaire. The second location was chosen in an attempt to improve the distribution of trips listed statewide and to reduce the likelihood of any bias associated with the first location representing "the big trip of the year" or the place fished most frequently.

6.2.2 Welfare Calculation

The same sample as the TCM is used to calculate welfare estimates in the CVM to avoid sampling bias when making comparisons. Among these samples, a large portion of the WTP information is lacking since half of the anglers responded to surveys that did not include CVM questions. Among those anglers who answered CVM questions, information was elicited about only one specific trip that they took. Observations have missing values in maximum willingness to pay, report travel cost and fishing days, which will be directly used to calculate the fishing values, were dropped.

Additionally, further elimination treatment is made to the data. The respondents who reported unreasonable answers, such as zero, are eliminated, to avoid the bad influence of strategic bias. Besides, those who reported unreasonably high answers were also eliminated so as not to impart a significant upward bias to the mean value. Since there is no objective criterion for the allowable maximum report value, we set the cutoff value at $200 per day following Connelly and Brown (1991). Thus 3.74% of the sample were excluded in this way. At last, 1,926 anglers (or observations) were left for analysis. We can calculate each individual's net WTP per day following:

$$V_i = \frac{WTP_i - Cost_i}{Day_i}, i = 1,2, \dots, n \qquad (6.2.2\text{-}1)$$

Where WTP_i denotes respondents' stated maximum willingness to pay. $Cost_i$ is people's reported travel cost during that trip. Day_i indicates the total days people spent in that specified trip.

Taking weighted average of all people's net WTP per day we can get the estimates of the average net economic value of fishing per day under contingent valuation methodology. This can be expressed by:

$$V^* = \frac{1}{n}\sum_{i=1}^{n} V_i \qquad (6.2.2\text{-}2)$$

CHAPTER 7

RESULTS

For the travel cost approach, three regressions were run in total, among which the first regression includes all variables described in Chapter 6. The second regression additionally includes the destination region dummies that angler fished at, and the third one further includes the residence region dummies in regression. Though there are nine DEC regions in New York State in total, only eight of them are included in regression to avoid multicollinearity problem. For consistency, the region omitted is Region 2, the New York City counties, in each regression. Additionally, in order to further eliminate the sampling bias when making comparisons between these two methods, a partial sample, which only includes anglers (1,926 in total), who have responded to the CVM questions, is used to redo the TCM regression.

The main results are represented in Table 6, the partial sampling results and a full table of main results are listed in Appendix 1. For the main result, the coefficient of travel cost shows an expected negative sign and is significant at 99% level in each regression. The coefficients on variables including Inland Lake shore length, Great Lake shore length, Inland Stream Length, and Inland Surface Area all shows an expected positive sign, indicating their positive influence on people's choice of fishing sites. The coefficients on demographic variables, including Income and Education level, give reasonable consistent signs and are all significant. The outcome is also consistent with utility maximizing behavior (Train, 2009) in all scale parameters, Sigma and Lambdas, are all between 0 and 1. Importantly, the coefficient Sigma is greater than the estimated Lambdas and the coefficient Lambda of Inland lakes is higher than the coefficient on Lambda of Great Lakes, indicating a higher independence among unobserved portion of utility of Inland Lake water bodies. All variables show consistent signs and are all significant across three regressions except for age, which is not significant in the first regression but is highly significant in the second and third regressions.

After estimating these models the consistent and efficient estimators of the coefficients can then be further employed to estimate the fishing values per angler per day. The value per angler per day ranges from \$23.11 to \$25.37 for main result, and ranges from \$27.97 to \$30.06 for the partial sampling corresponding to the CVM (For more detail, see Appendix 2). When multiplying by the number of estimated angler days, we can get the fishing value per year.

In addition, the change of welfare due to closure of certain counties is also estimated, which is shown in Table 6. The change in the site availability is simulated by removing Oswego County from angler's fishing choice set and assume that angler who did go fishing in Oswego would switch to fishing sites that provides largest utility other than Oswego. After re-calculation, the closure results in an average economic yearly loss ranges from \$27.14 to \$29.28 per angler. When multiplied by the angler amounts, which is 1,013,000 in 1988, the yearly loss for all anglers from the closure of Oswego ranges from \$27.49 to \$29.66 million.

Table 7 summarizes all estimation results concerning with TCM, including the estimated daily recreational fishing value (derive directly from Table 6); unadjusted[1] yearly fishing value, which equals the daily value multiplied by the unadjusted angler days in 1988; adjusted[2] yearly fishing value, equaling estimated daily value multiplied by the adjusted angler days in 1988; yearly loss from county closure per angler; and yearly loss from county closure for all anglers, which equals loss per angler multiplied by angler number.

[1] Unadjusted: In the NYSDEC report in 1988, Nancy Connelly had adjusted the yearly angler fishing days considering the non-response rate. So unadjusted means the angler days used here is the number before adjustment.
[2] Adjusted: In the NYSDEC report in 1988, Nancy Connelly had adjusted the yearly angler fishing days considering the non-responds rate. So unadjusted means the angler days used here is the number after adjustment.

Table 7: Regression Outcome of Nested Logit Travel Cost Model

Variables	(1)	(2)	(3)	(4)
Value ($ per angler day)	23.11	24.73	24.83	25.37
	(0.402)	(0.430)	(0.380)	(0.389)
Travel Cost ($/100)	-2.38	-2.32	-2.61	-2.57
	(0.026)***	(0.025)***	(0.026)***	(0.026)***
Inland Shore Length (mi/100)	0.04	0.01	0.03	0.01
	(0.001)***	(0.001)***	(0.001)***	(0.001)***
GL Shore Length (mi/100)	1.39	1.38	1.55	1.57
	(0.025)***	(0.027)***	(0.028)***	(0.030)***
Inland Stream Length (mi/1000)	0.17	0.19	0.21	0.22
	(0.002)***	(0.003)***	(0.003)***	(0.003)***
Inland Surface Area (mi/100)	0.61	0.62	0.79	0.74
	(0.011)***	(0.012)***	(0.013)***	(0.014)***
Constant	-3.75	-4.51	-3.89	-4.44
	(0.017)***	(0.030)***	(0.030)***	(0.037)***
Gender(Female=1)	0.02	0.02	0.05	0.05
	(0.008)***	(0.008)***	(0.008)***	(0.008)***
Age	0.003	0.003	0.003	0.003
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Reported Income ($/100,000)	0.01	-0.03	-0.08	-0.10
	(0.019)	(0.019)**	(0.019)***	(0.019)***
Education Level(college)	-0.26	-0.26	-0.26	-0.26
	(0.007)***	(0.007)***	(0.007)***	(0.007)***
Great Lakes Dummy	0.01	0.10	0.11	0.13
	(0.010)	(0.010)***	(0.011)***	(0.011)***
Sigma	0.55	0.57	0.65	0.65
	(0.004)***	(0.005)***	(0.005)***	(0.005)***
Lambda 1	0.39	0.39	0.43	0.43
	(0.004)***	(0.004)***	(0.004)***	(0.004)***
Lambda 2	0.32	0.31	0.35	0.33
	(0.004)***	(0.004)***	(0.004)***	(0.004)***
Region of Residence Dummy	**N**	**N**	**Y**	**Y**
Region of Destination Dummy	**N**	**Y**	**N**	**Y**
Maximum Log-likelihood	795,578	790,451	793,411	788,392
Number of Observation	11,614	13,614	13,614	13,614
Number of Angler	5,333	5,333	5,333	5,333

Note: Standard errors are in brackets. ***indicate significant at 99% level, **indicate significant at 95% level, *indicate significant at 90% level.

Table 8: Estimates of Fishing Values and Value Loss from County Closure

	(1)	(2)	(3)	(4)
Value per day($)	23.11	24.73	24.83	25.37
	(0.402)	(0.430)	(0.380)	(0.389)
Value per Year(million $), unadjusted	573.76	614.06	616.46	629.79
	(18.229)	(19.501)	(18.286)	(18.717)
Value per year(million $), adjusted	479.91	513.62	515.63	526.78
Loss from county closure per angler($/year)	28.76	29.28	28.39	27.14
Loss from county closure(million $/year)	29.13	29.66	28.76	27.49

Note: Standard error in brackets.

For the Contingent Valuation approach, the mean net WTP per day is $24.96 (with a standard deviation of $28.67). When multiplying the adjusted angler days, this gives an estimated fishing value of $518.34 million in year 1988.

CHAPTER 8

CONCLUSION

The estimates of recreational fishing value in New York State in 1988 is $24.96 for Contingent Valuation Method. For Nested-Logit Travel Cost Method the estimates range from $23.11 to $25.37 and from $27.97 to $30.06 using full sample and subsamples that correspond to CVM respectively. The deviation between the TCM estimates using the full sample and its subsample may derive from the deletion of "zero" responses regardless of its latent generation philosophy[1]. When multiplying the estimated angler days in 1988, we get an estimate of yearly fishing value of $518.34 million for CVM, and $479.91-$526.78 million (or $598.50-$624.24 million for partial sampling) for TCM. The estimation outcomes show obvious convergence between CVM and TCM from both daily and yearly perspectives with the value obtained from CVM being not significantly different from TCM.

The convergence between these two estimates is consistent with our expectation and match with outcomes from previous studies. As having stated in Chapter 3, convergent validity concerns the correspondence between a measure and other measures of the same theoretical construct. To the extent that a correlation exists, the validity of each measure is supported. While convergent validity tests of this type are not possible for passive use values, they can be carried out for private or quasi-public goods, such as recreational resources. This study have used both

[1] People respond zero value in open-ended CVM questions because of many reasons, including: people can't afford to pay anything; the good is not important to them; and they don't think they should have to pay for the good (Freeman 2003). Only the third response would be classified as protest zeros that should be deleted from the sample. However, in 1988 NYSAS, no further question was asked to elicit these latent reasons, so following Connelly and Brown (1991), I exclude all the zero responses in this study. This will directly result in the problem that people who do pay little in that specific fishing trip and give zero response were excluded. When people who actually pay little in travel cost are excluded, the fishing value would be overestimated using TCM.

CVM and TCM to examine how the environment conveys value through recreation and having proved the convergent validity of both CVM and TCM.

Though the estimates of this study show obvious convergence using these two methods, their latent differences shouldn't be ignored. For CVM, the measures of WTP are not grossly sensitive to specification and estimation, but it can be very sensitive to the collection of data. However, for TCM, the estimate of WTP is severely sensitive to specification and estimation decisions. Previous empirical evidences have shown that, integrating "time" factor in travel cost (or price) variable can make a great difference in estimate outcomes, and the weight of the time cost (i.e. 1/2 or 1/3 of wage rate) set in the demand function exerts great influence as well. In this study, I include time cost as one of the travel cost components and setting the opportunity cost at one-third of individual's wage rate, which will definitely give a different estimation from models with different specifications (i.e. exclude time cost factor; set the opportunity cost at half wage rate). Additionally, the calculated distance I used will to some extend result in an underestimate of fishing value using TCM, since the calculated distance is lower than reported ones on average.

Furthermore, we should pay attention that CVM questions elicit people's willingness to pay based on their consideration for both use value and non-use value of certain merchandise, while TCM limits its measuring scope to use value. This also consists one of the major reasons for previous studies who getting a CVM estimate higher than TCM. In NYSAS 1988, the survey successfully avoided this deviation by including only anglers who did go fishing in that year, and the question "What is the maximum total amount you would have been willing to pay for this fishing trip before you would have decided not to go" leaves no signs to motivate respondents to consider non-use values when making decisions.

CHAPTER 9

DISCUSSION

This study attempts to compare the recreational fishing value estimated from two different non-market valuation approaches, the travel cost method (TCM) and the contingent valuation method (CVM). However, limitations still exist in this study and suggestions for future research are made partially based on these.

9.1 Limitations

Similar limitations noted in Spink's (2014) analysis of the 2007 New York State Angler Survey (NYSAS) appear in this study, in that distance and travel time variables in the TCM model are approximately calculated using residence zip code as origin and fishing site county as destination. Since accurate calculation of point-to-point distance and time is not possible for current study, this zip-to-county calculation method is a possible bias to valuation results. Although NYSAS includes people's reported distance from origin to destination, it is not possible to obtain distances for every route between origin and destination in an individual's choice set of possible fishing sites. Although not used in technical sphere, the reported distance may be more accurate than calculated distance and the description of the two source of distance shows that the reported distance is larger than the calculated distance. Similarly, we can deduct that the actual travel time is also higher than the calculated time spent between origin-county and destination-county. A further limitation of this analysis, as in most travel cost studies, is the necessity of assuming an opportunity cost of time. The assumption that the opportunity cost of time is one third of the wage for all people in this study may not be appropriate since this cost may vary person to person.

Some data on individual fishing site characteristics are lacking, especially variables concerning fish stock, catch rate and habitat score, etc. Existing site features are by county, and the lacking of site quality variables result in the inability to calculate the welfare effects of changes in site quality.

Besides, in the CVM study, the survey question was conducted in a simple open-ended form, and no further effort was made to improve the incentive-compatibility and the consequentiality of questions. Additionally, “protest zeros” were not identified and eliminated. These issues, to some extent, weakened the validity and reliability of the value estimated using this method.

9.2 Further Research

The 1988 NYSAS provides possibility to estimate recreational fishing values in New York State using both CVM and TCM by designing half of distributed questionnaires including CVM questions. A similar survey was conducted in 1996 and similar study using both methods is on the way. After the completion of this correlated study, it is feasible for us to compare the outcomes and test the consistency of the estimates across time.

In addition, NYSAS was also conducted in 2007 without CVM questions in this survey. Although losing the opportunity to inspecting the relationship of CVM and TCM estimates through three decades in one state, comparing the TCM estimates over this time period is available then. This is very important because determining how these estimates change over time could be a very important indicator to determine how often the estimated value of recreational fishing using TCM needs to be updated.

Furthermore, future studies can include other discrete choice models, like mixed logit model, in regression, thus further test and improve the fishing values estimated in New York State.

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APPENDIX I

RESULTS

Table 9: Regression Outcome of Nested Logit Travel Cost Model (Full Table)

Variables	(1)	(2)	(3)	(4)
Value ($ per angler day)	23.11	24.73	24.83	25.37
	(0.402)	(0.430)	(0.380)	(0.389)
Travel Cost ($/100)	-2.38	-2.32	-2.61	-2.57
	(0.026)***	(0.025)***	(0.026)***	(0.026)***
Inland Shore Length (mi/100)	0.04	0.01	0.03	0.01
	(0.001)***	(0.001)***	(0.001)***	(0.001)***
GL Shore Length (mi/100)	1.39	1.38	1.55	1.57
	(0.025)***	(0.027)***	(0.028)***	(0.030)***
Inland Stream Length (mi/1000)	0.17	0.19	0.21	0.22
	(0.002)***	(0.003)***	(0.003)***	(0.003)***
Inland Surface Area (mi/100)	0.61	0.62	0.79	0.74
	(0.011)***	(0.012)***	(0.013)***	(0.014)***
Constant	-3.75	-4.51	-3.89	-4.44
	(0.017)***	(0.030)***	(0.030)***	(0.037)***
Gender(Female=1)	0.02	0.02	0.05	0.05
	(0.008)***	(0.008)***	(0.008)***	(0.008)***
Age	0.003	0.003	0.003	0.003
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Reported Income ($/100,000)	0.01	-0.03	-0.08	-0.10
	(0.019)	(0.019)**	(0.019)***	(0.019)***
Education Level(college)	-0.26	-0.26	-0.26	-0.26
	(0.007)***	(0.007)***	(0.007)***	(0.007)***
Great Lakes Dummy	0.01	0.10	0.11	0.13
	(0.010)	(0.010)***	(0.011)***	(0.011)***
Sigma	0.55	0.57	0.65	0.65
	(0.004)***	(0.005)***	(0.005)***	(0.005)***
Lambda 1	0.39	0.39	0.43	0.43
	(0.004)***	(0.004)***	(0.004)***	(0.004)***
Lambda 2	0.32	0.31	0.35	0.33
	(0.004)***	(0.004)***	(0.004)***	(0.004)***
Destination Region 1		1.07		1.28
		(0.022)***		(0.025)***
Destination Region 3		0.97		1.07
		(0.021)***		(0.024)***
Destination Region 4		0.70		0.90
		(0.020)***		(0.023)***
Destination Region 5		0.99		1.23
		(0.021)***		(0.025)***
Destination Region 6		0.78		1.08
		(0.021)***		(0.025)***

Destination Region 7		0.69		0.95
		(0.020)***		(0.024)***
Destination Region 8		0.56		0.70
		(0.020)***		(0.022)***
Destination Region 9		0.72		0.83
		(0.021)***		(0.024)***
Origin Region 1			0.37	0.19
			(0.033)***	(0.032)***
Origin Region 3			0.33	-0.09
			(0.027)***	(0.027)***
Origin Region 4			-0.02	-0.51
			(0.027)	(0.027)***
Origin Region 5			0.18	-0.34
			(0.027)***	(0.028)***
Origin Region 6			-0.46	-0.90
			(0.028)***	(0.029)***
Origin Region 7			-0.22	-0.60
			(0.027)***	(0.027)***
Origin Region 8			-0.10	-0.33
			(0.027)***	(0.027)***
Origin Region 9			-0.02	-0.30
			(0.027)	(0.027)***
Maximum Log-likelihood	795,578	790,451	793,411	788,392
Number of Observation	11,614	13,614	13,614	13,614
Number of Angler	5,333	5,333	5,333	5,333

Note: Standard errors are in brackets. ***indicate significant at 99% level, **indicate significant at 95% level, *indicate significant at 90% level.

Table 10: Regression Outcome of Nested Logit Travel Cost Model (Partial Sample)

Variables	(1)	(2)	(3)	(4)
Value ($ per angler day)	27.97	29.02	30.06	29.92
	(0.887)	(0.929)	(0.809)	(0.812)
Travel Cost ($/100)	-2.00	-2.02	-2.31	-2.32
	(0.040)***	(0.041)***	(0.041)***	(0.041)***
Inland Shore Length (mi/100)	0.03	0.01	0.02	0.01
	(0.002)***	(0.002)***	(0.002)***	(0.002)***
GL Shore Length (mi/100)	1.17	1.28	1.38	1.50
	(0.041)***	(0.045)***	(0.047)***	(0.051)***
Inland Stream Length (mi/1000)	0.17	0.19	0.22	0.22
	(0.004)***	(0.005)***	(0.005)***	(0.006)***
Inland Surface Area (mi/100)	0.58	0.54	0.76	0.67
	(0.018)***	(0.019)***	(0.022)***	(0.023)***
Constant	-3.75	-4.56	-3.61	-4.44
	(0.030)***	(0.052)***	(0.047)***	(0.064)***
Gender(Female=1)	0.11	0.10	0.12	0.12
	(0.013)***	(0.013)***	(0.013)***	(0.013)***
Age	0.0005	0.0004	0.0006	0.0006
	(0.000)	(0.000)	(0.000)**	(0.000)**
Reported Income ($/100,000)	0.05	0.03	-0.03	-0.03
	(0.033)	(0.033)	(0.033)	(0.033)
Education Level(college)	-0.33	-0.33	-0.34	-0.34
	(0.013)***	(0.013)***	(0.013)***	(0.013)***
Great Lakes Dummy	-0.11	-0.02	0.03	0.05
	(0.020)***	(0.020)	(0.021)***	(0.021)***
Sigma	0.56	0.59	0.70	0.69
	(0.008)***	(0.008)***	(0.008)***	(0.008)***
Lambda 1	0.35	0.36	0.41	0.42
	(0.007)***	(0.007)***	(0.007)***	(0.008)***
Lambda 2	0.25	0.25	0.29	0.28
	(0.006)***	(0.006)***	(0.006)***	(0.006)***
Destination Region 1		0.82		0.99
		(0.038)***		(0.044)***
Destination Region 3		0.95		1.06
		(0.037)***		(0.041)***
Destination Region 4		0.77		0.97
		(0.035)***		(0.040)***
Destination Region 5		1.01		1.25
		(0.037)***		(0.043)***
Destination Region 6		0.79		1.08
		(0.035)***		(0.042)***

Destination Region 7		0.77		1.04
		(0.035)***		(0.041)***
Destination Region 8		0.61		0.77
		(0.034)***		(0.039)***
Destination Region 9		0.71		0.86
		(0.036)***		(0.041)***
Origin Region 1			-0.25	0.00
			(0.059)***	(0.061)
Origin Region 3			0.06	-0.11
			(0.042)***	(0.047)***
Origin Region 4			-0.25	-0.50
			(0.043)***	(0.048)***
Origin Region 5			-0.14	-0.42
			(0.043)***	(0.048)***
Origin Region 6			-0.92	-1.10
			(0.045)***	(0.050)***
Origin Region 7			-0.56	-0.73
			(0.042)***	(0.047)***
Origin Region 8			-0.45	-0.47
			(0.042)***	(0.047)***
Origin Region 9			-0.44	-0.47
			(0.043)***	(0.048)***
Maximum Log-likelihood	268,629	267,134	267,775	266,303
Number of Observation	5,073	5,073	5,073	5,073
Number of Angler	1,926	1,926	1,926	1,926

Note: Standard errors are in brackets. ***indicate significant at 99% level, **indicate significant at 95% level, *indicate significant at 90% level.

APPENDIX II

The 1988 New York State Angler Survey

Tan

NEW YORK FRESHWATER FISHING SURVEY

1988 NEW YORK STATEWIDE FRESHWATER FISHING SURVEY

Research conducted by the

CORNELL UNIVERSITY COLLEGE OF AGRICULTURE AND LIFE SCIENCES

Department of Natural Resources

in cooperation with

the NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

This study concerns your sport fishing in New York State during the 1988 calendar year. We would like you, as the addressee, to fill out the questionnaire, counting only the fishing you personally did or the dollars you personally spent.

Your answers to the following questions will help us draw a composite picture of 1988 New York anglers, their fishing, and their opinions and preferences about a number of fishing topics.

THANK YOU FOR YOUR COOPERATION.

1988 NEW YORK STATEWIDE FRESHWATER FISHING SURVEY

1. Did you go freshwater fishing in New York between January 1 and December 31, 1988?

   _____YES (Please continue with Question 2)

   _____NO (If you did not go freshwater fishing in New York in 1988 please skip to Question 17).

Fishing Preferences and Interests

2. Some waters can be managed to produce more large (15 inches or more) largemouth and smallmouth bass, but this usually requires that anglers keep fewer fish. Or, these waters can be managed to provide greater numbers of bass for anglers to harvest, but with fewer large fish. Which option do you prefer?

   _____More large (15 inches or greater) bass, but fewer fish available for harvest

   _____More bass available for harvest, but with fewer large fish

   _____No preference

3. Higher minimum size limits for trout in streams can produce larger catches, more "recycling" of stocked fish caught and released, and modest gains in the total weight of the take home catch. But anglers would be allowed to take home fewer of these larger trout. Which option do you prefer?

   _____Increased use of higher minimum size limits, more larger trout to catch, but fewer to take home

   _____No change from existing conditions

   _____Decreased use of higher minimum size limits for trout and allow keeping of smaller trout

   _____No preference

4. Hook and line caught fish that are not protected by law, such as yellow perch, crappie, bluegill, and bullheads, may be sold legally. Do you think the sale of these species should be:

   _____Unregulated, as it is now

   _____Kept legal, but regulated

   _____Prohibited entirely

   _____No opinion

5a. Have you ever participated in fishing tournaments such as the ESLO Derby, bass derbies, or other tournaments or derbies in New York?

_____ YES _____NO

b. What is your general attitude about such tournaments or derbies?

____ I like the idea of having such tournaments

____ I have little interest in tournaments, but do not oppose them

____ I am opposed to fishing derbies and tournaments

6. Think of the type of fishing trip you enjoy the most. How important are the following factors to making the trip a really satisfying experience for you? (Circle one number for each item.)

0 = Of no concern at all
1 = Not very important
2 = Somewhat important
3 = Important but not essential
4 = Essential for a really satisfying trip

	No Concern				Essential
a. Catching several fish	0	1	2	3	4
b. Catching a large fish	0	1	2	3	4
c. Catching at least one fish	0	1	2	3	4
d. Catching a particular type of fish	0	1	2	3	4
e. Being with friends or family	0	1	2	3	4
f. Being where the scenery is pleasant	0	1	2	3	4
g. Fishing in areas where I know the fish are safe to eat	0	1	2	3	4
h. Trying out new fishing gear	0	1	2	3	4
i. Mastering fishing skills	0	1	2	3	4
j. Catching the most fish of anyone in my group	0	1	2	3	4
k. Catching fish to eat	0	1	2	3	4
l. Fishing where there are few other people	0	1	2	3	4
m. Exploring new fishing areas	0	1	2	3	4

7. About how many meals of fish (fresh or saltwater) did you consume last year? (We are interested in any fish that you ate, whether sport-caught or purchased fresh, canned, or frozen at a store or restaurant.)

I ate approximately _____ fish meals in 1988.

8. About how many meals of sport-caught fish from Lakes Erie and/or Ontario (and their tributaries) did your household consume last year? Please include only meals of fish from these waters, whether you or someone else caught them.

I ate approximately _____meals of fish from Lake Ontario.

I ate approximately _____meals of fish from Lake Erie.

9. Please indicate which of the following methods you use to prepare and eat any sport-caught fish in your household. Circle the number for each item that best describes your actions.

1=Always; 2=Usually; 3=Sometimes; 4=Rarely; 5=Never

	Always				Never
a. Trim belly meat	1	2	3	4	5
b. Trim the strip of fat along the back of the fish	1	2	3	4	5
c. Puncture or remove the skin	1	2	3	4	5
d. Eat whole fish	1	2	3	4	5
e. Fillet the fish	1	2	3	4	5
f. Pan fry or deep fry	1	2	3	4	5
g. Make fish soups or chowders	1	2	3	4	5
h. Bake, barbecue, or poach fish	1	2	3	4	5
i. Reuse oil or fat from cooking fish	1	2	3	4	5

IN THE FOLLOWING SECTION "GREAT LAKES FISHING" REFERS TO THE NEW YORK PORTION OF LAKE ERIE, THE NIAGARA RIVER, LAKE ONTARIO, AND GREAT LAKES TRIBUTARIES UP TO THE FIRST BARRIER IMPASSABLE TO FISH.

---

10. Have you gone Great Lakes fishing within the past 5 years?

_____YES _____NO

11. Do you think you will go Great Lakes fishing in 1989?

_____YES _____NO

12. If you answered "No" to **either Q10 or Q11** please indicate below why you have not fished the Great Lakes in the past 5 years and/or do not plan to in 1989. (If you checked "Yes" to **both Q10 and Q11, skip to Q13).**

Reasons for not fishing Great Lakes in past 5 years or in 1989
(Check any important reason; you may check more than 1 reason):

_____ Too far from home

_____ Don't have the necessary boat or equipment

_____ Due to contaminants, I wouldn't want to eat the fish

_____ Fishing is too crowded

_____ Snaggers (snatchers) would ruin the experience for me

_____ Don't have a companion who is interested in Great Lakes fishing

_____ Don't have the knowledge or skills for Great Lakes fishing

13. Of the legal size fish you catch in Lakes Erie and Ontario (including their tributaries), about what percent are:

	Lake Ontario	Lake Erie
Released	_____%	_____%
Eaten by you or your family	_____%	_____%
Given away	_____%	_____%
Thrown away or otherwise disposed of	_____%	_____%
	100 %	100 %

14. Have you ever gone snagging (snatching) or lifting for Great Lakes salmon?

_____Yes: When did you last go snagging or lifting? 19____

_____No

15. How do you feel about the number and length of Great Lakes tributary sections where snagging (snatching) of Pacific salmon is allowed? (Snagging is currently permitted on one section only of 4 Lake Erie, and 11 Lake Ontario tributaries). (Check one):

____ Snagging should be permitted more widely on Great Lakes tributaries.

____ The amount of stream frontage where snagging is now allowed is about right.

____ The amount of frontage open to snagging should be reduced.

____ All snagging of Pacific salmon on the Great Lakes should be eliminated.

____ I have no opinion about snagging.

16a. FISHING LOCATION AND EXPENSE TABLE.
Please answer the questions below about all your freshwater fishing IN NEW YORK FROM JANUARY 1 to DECEMBER 31, 1988. Since we are only interested in totals for each location, please list each location only once.

LOCATION	WHERE DID YOU FISH IN NEW YORK? (Please indicate below)			HOW MANY TRIPS DID YOU TAKE AND HOW MANY TOTAL DAYS DID YOU FISH AT EACH LOCATION?	
	NAME OF STREAM OR LAKE	COUNTY OR NEAREST POST OFFICE	APPROXIMATE MILEAGE FROM YOUR HOME (ONE WAY)	NUMBER OF TRIPS	NUMBER OF DAYS FISHED
EXAMPLE	Indian Lake	Hamilton	90	4	8
1					
2					
3					
4					
5					
6					
7					
8					

16b. If you feel that boat access facilities need improvement at any of the locations you listed in lines 1-8 above, circle the number corresponding to the line(s) in which that location is listed:

1 2 3 4 5 6 7 8

ON HOW MANY OF THOSE DAYS WERE YOU FISHING PRIMARILY FOR THE FOLLOWING TYPES OF FISH? (Your total for each location should equal the number of days fished in the preceding column.)

HOW MUCH DID YOU SPEND FOR ALL TRIPS TO EACH LOCATION? (Gas and oil, food, lodging, rental of boat and tackle, bait, etc.)

Yellow Perch	Walleye (Yellow Pike)	Bass	Bluegill/Sunfish	Northern Pike	Muskie	Chain Pickerel	Lake Trout	Rainbow/Steelhead Trout	Brown Trout	Coho or Chinook Salmon	Atlantic/Landlocked Salmon	Brook Trout	Bullheads/Catfish	Other	No Specific Type	TOTAL SPENT AT EACH LOCATION	TOTAL SPENT WHILE TRAVELING TO AND FROM EACH FISHING LOCATION
		5					1								2	$175	$45

Fish Contaminants and Advisories

17. Sportfish in a number of New York waterways have been found to contain levels of chemical contaminants which may pose health risks to fish consumers. The New York Department of Environmental Conservation distributes a health advisory written by the Department of Health which gives advice about limiting consumption of fish from certain waters of the State.

    a. Have you heard or read about these health advisories?

    _____ No (Go to Q20)

    _____ Yes

    b. Which of the following information sources made you aware of the health advisories? (Please check all that apply.)

    _____ Newspaper article or editorial
    _____ Magazine article
    _____ Fishing, Small Game Hunting, and Trapping Regulations Guide
    _____ Newsletters from fishing clubs
    _____ Cooperative Extension information
    _____ New York Sea Grant information
    _____ New York State Fisheries agency personnel
    _____ Warnings posted on waters that I fish
    _____ Friends
    _____ Television or radio
    _____ Guides or charterboat operators
    _____ Other (please specify) ____________________

18. Please check whether you agree, disagree, or have no opinion about each of the following statements:

	Agree	Disagree	No Opinion
a. The health advisories provide me with enough information to decide whether or not to eat certain fish.	_____	_____	_____
b. Many of the advisories are not needed, or are exaggerated.	_____	_____	_____

19. Since you learned about the health advisories, have you made any changes in either your fishing habits or in the way you eat the fish you catch?

_____ No. I made no changes as a result of the advisories. (GO TO Q20)

_____ Yes. What changes have you made? (Please check all that apply.)

- _____ I no longer eat any sport-caught fish.
- _____ I eat less fish now than before the advisories.
- _____ I eat more fish now because I can choose to keep fish from waters where there are less serious advisories.
- _____ I have changed the ways I clean and/or prepare sport-caught fish before eating them.
- _____ I have changed fishing locations because of the advisories.
- _____ I take fewer fishing trips since learning about the advisories.
- _____ I take more fishing trips now because I can choose waters with less serious contaminant problems.
- _____ I have changed the species I fish for because of the advisories.

20. Please check YES, NO, or NOT SURE for each statement below:

	YES	NO	NOT SURE
a. I believe chemical contaminants in fish pose some danger to me.	_____	_____	_____
b. I usually fish in waters where contaminants are not a problem.	_____	_____	_____
c. I usually fish for species in which contaminants are not a problem.	_____	_____	_____
d. I would like more information about the potential risks to me from eating fish with chemical contaminants.	_____	_____	_____
e. I would like more information about how the risks of eating certain fish compare with other risks I encounter in life.	_____	_____	_____

THE FOLLOWING INFORMATION WILL HELP US CATEGORIZE FISHING PARTICIPATION IN NEW YORK AND PREDICT FUTURE INTEREST IN FISHING. ALL INFORMATION IS KEPT STRICTLY CONFIDENTIAL AND IS NEVER ASSOCIATED WITH YOUR NAME.

21. How many years have you been a resident of New York State?

_____ Years

22. Which of the following best describes the area where most of your first 16 years were spent (Check one):

_____ Rural, hamlet, or village (under 5,000 population)

_____ City of 5,000 to 24,999 population

_____ City of 25,000 to 99,999 population

_____ Major city of over 100,000 population

_____ Suburb of major city

23. At what age did you first fish on a fairly regular basis (at least 5 days per year)?

Age when you first started fishing regularly: _____

Check here _____ if you have only fished occasionally in the past

24. In approximately what year did you buy your FIRST New York fishing license?

19____

25. Prior to last year (the October 1, 1987 through September 30, 1988 license year), in which of the previous 3 years do you think you bought a license that permits fishing in New York (check all that apply):

____1986-87 ____1985-86 ____1984-85

26. As of today, have you purchased a license that permits fishing in New York in 1989?

____Yes

____No: If not, do you think you will buy a 1988-89 New York license?

____Yes ____No ____Uncertain

27. Did you go hunting in New York between January 1 and December 31, 1988?

____Yes ____No

28. Are you presently a member of a fish and game club or an organized sportsman's group?

____ YES ____ NO

29. How many years of school did you complete, counting 12 years for high school graduation and 1 year for each additional year of college, technical, or vocational training?

_____ years

30. Please circle your approximate TOTAL HOUSEHOLD INCOME before taxes, in thousands of dollars:

5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
20	22	24	26	28	30	32	34	36	38	40	45	50	55	
60	65	70	75	80	More than 80									

Cornell University normally follows a policy of never associating your name with the information you provide. However, it would be extremely valuable to state fisheries managers to be able to contact a sample of anglers who fish a particular waterway at some point in the future. If information is needed in the future that pertains to a waterway that you have fished, may Cornell University or DEC contact you for further information? (Other information such as your education or income would still be kept confidential and not associated with your name).

_____YES _____NO

THANK YOU FOR YOUR COOPERATION.

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NEW YORK FRESHWATER FISHING SURVEY

1988 NEW YORK STATEWIDE FRESHWATER FISHING SURVEY

Research conducted by the

CORNELL UNIVERSITY COLLEGE OF AGRICULTURE AND LIFE SCIENCES

Department of Natural Resources

in cooperation with

the NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

This study concerns your sport fishing in New York State during the 1988 calendar year. We would like you, as the addressee, to fill out the questionnaire, counting only the fishing you personally did or the dollars you personally spent.

Your answers to the following questions will help us draw a composite picture of 1988 New York anglers, their fishing, and their opinions and preferences about a number of fishing topics.

THANK YOU FOR YOUR COOPERATION.

1988 NEW YORK STATEWIDE FRESHWATER FISHING SURVEY

1. Did you go freshwater fishing in New York between January 1 and December 31, 1988?

   _____YES (Please continue with Question 2)

   _____NO (If you did not go freshwater fishing in New York in 1988 please skip to Question 17).

Fishing Preferences and Interests

2. Some waters can be managed to produce more large (15 inches or more) largemouth and smallmouth bass, but this usually requires that anglers keep fewer fish. Or, these waters can be managed to provide greater numbers of bass for anglers to harvest, but with fewer large fish. Which option do you prefer?

   _____More large (15 inches or greater) bass, but fewer fish available for harvest

   _____More bass available for harvest, but with fewer large fish

   _____No preference

3. Higher minimum size limits for trout in streams can produce larger catches, more "recycling" of stocked fish caught and released, and modest gains in the total weight of the take home catch. But anglers would be allowed to take home fewer of these larger trout. Which option do you prefer?

   _____Increased use of higher minimum size limits, more larger trout to catch, but fewer to take home

   _____No change from existing conditions

   _____Decreased use of higher minimum size limits for trout and keeping of all small trout

   _____No preference

4. Hook and line caught fish that are not protected by law, such as yellow perch, crappie, bluegill, and bullheads, may be sold legally. Do you think the sale of these species should be:

   _____Unregulated, as it is now

   _____Kept legal, but regulated

   _____Prohibited entirely

   _____No opinion

5a. Have you ever participated in fishing tournaments such as the ESLO Derby, bass derbies, or other tournaments or derbies in New York?

_____ YES _____ NO

b. What is your general attitude about such tournaments or derbies?

_____ I like the idea of having such tournaments

_____ I have little interest in tournaments, but do not oppose them

_____ I am opposed to fishing derbies and tournaments

6. Think of the type of fishing trip you enjoy the most. How important are the following factors to making the trip a really satisfying experience for you? (Circle one number for each item.)

0 = Of no concern at all
1 = Not very important
2 = Somewhat important
3 = Important but not essential
4 = Essential for a really satisfying trip

	No Concern				Essential
a. Catching several fish	0	1	2	3	4
b. Catching a large fish	0	1	2	3	4
c. Catching at least one fish	0	1	2	3	4
d. Catching a particular type of fish	0	1	2	3	4
e. Being with friends or family	0	1	2	3	4
f. Being where the scenery is pleasant	0	1	2	3	4
g. Fishing in areas where I know the fish are safe to eat	0	1	2	3	4
h. Trying out new fishing gear	0	1	2	3	4
i. Mastering fishing skills	0	1	2	3	4
j. Catching the most fish of anyone in my group	0	1	2	3	4
k. Catching fish to eat	0	1	2	3	4
l. Fishing where there are few other people	0	1	2	3	4
m. Exploring new fishing areas	0	1	2	3	4

Boating Section

7. Do you, or does your family own a boat or canoe that you used while fishing in New York in 1988?

   ____NO; SKIP TO THE NEXT PAGE ON GREAT LAKES FISHING TOPICS (Q. 9)

   ____YES; PLEASE ANSWER THE FOLLOWING SECTION ABOUT YOUR BOAT(S)

8. Please describe your boat(s) and/or canoe(s) below.

	Boat 1	Boat 2
Length of boat in feet	________ft	_______ft
Horsepower of engine(s)	________hp	_______hp
Year manufactured	19____	19____
Year you purchased boat	19____	19____
Estimated current value of boat, motor, and equipment	$________	$_______
Engine type (Check one per boat):		
unpowered	_____	_____
inboard	_____	_____
outboard	_____	_____
inboard/outboard	_____	_____
Type of fuel (if powered)	____gasoline	____gasoline
	____diesel	____diesel
About what percent of the total use of this boat is for fishing?	____ %	____ %
This boat is usually (Check one for each boat):		
a. trailered or hauled to the fishing site	____	____
b. carried on cartop to the fishing site	____	____
c. kept at a marina/yacht club	____	____
d. kept at a private dock	____	____

IN THE FOLLOWING SECTION "GREAT LAKES FISHING" REFERS TO THE NEW YORK PORTION OF LAKE ERIE, THE NIAGARA RIVER, LAKE ONTARIO, AND GREAT LAKES TRIBUTARIES UP TO THE FIRST BARRIER IMPASSABLE TO FISH.

9. Have you gone Great Lakes fishing within the past 5 years?

_____YES _____NO

10. Do you think you will go Great Lakes fishing in 1989?

_____YES _____NO

11. If you answered "No" to **either Q9 or Q10** please indicate below why you have not fished the Great Lakes in the past 5 years and/or do not plan to in 1989. (If you checked "Yes" to **both Q9 and Q10, skip to Q12)**.

<u>Reasons for not fishing Great Lakes in past 5 years or in 1989:</u>
(Check any important reason; you may check more than 1 reason):

_____ Too far from home

_____ Don't have the necessary boat or equipment

_____ Don't have the knowledge or skills for Great Lakes fishing

_____ Fishing is too crowded

_____ Snaggers (snatchers) would ruin the experience for me

_____ Don't have a companion who is interested in Great Lakes fishing

_____ Due to contaminants, I wouldn't want to eat the fish

12. Have you ever gone snagging (snatching) or lifting for Great Lakes salmon?

_____Yes: When did you last go snagging or lifting? 19____

_____No

13. How do you feel about the number and length of Great Lakes tributary sections where snagging (snatching) of Pacific salmon is allowed? (Snagging is currently permitted on one section only of 4 Lake Erie, and 11 Lake Ontario tributaries). (Check one):

____ Snagging should be permitted more widely on Great Lakes tributaries.

____ The amount of stream frontage where snagging is now allowed is about right.

____ The amount of frontage open to snagging should be reduced.

____ All snagging of Pacific salmon on the Great Lakes should be eliminated.

____ I have no opinion about snagging.

14a. FISHING LOCATION AND EXPENSE TABLE.
Please answer the questions below about all your freshwater fishing IN NEW YORK FROM JANUARY 1 to DECEMBER 31, 1988. Since we are only interested in totals for each location, please list each location only once.

LOCATION	WHERE DID YOU FISH IN NEW YORK? (Please indicate below)			HOW MANY TRIPS DID YOU TAKE AND HOW MANY TOTAL DAYS DID YOU FISH AT EACH LOCATION?	
	NAME OF STREAM OR LAKE	COUNTY OR NEAREST POST OFFICE	APPROXIMATE MILEAGE FROM YOUR HOME (ONE WAY)	NUMBER OF TRIPS	NUMBER OF DAYS FISHED
EXAMPLE	Indian Lake	Hamilton	90	4	8
1					
2					
3					
4					
5					
6					
7					
8					

14b. If you feel that boat access facilities need improvement at any of the locations you listed in lines 1-8 above, circle the number corresponding to the line(s) in which that location is listed:

1 2 3 4 5 6 7 8

N HOW MANY OF THOSE DAYS WERE YOU FISHING <u>PRIMARILY</u> FOR HE FOLLOWING TYPES OF FISH? (Your total for each ocation should equal the number of days fished in the receding column.)

HOW MUCH DID YOU SPEND FOR <u>ALL</u> TRIPS TO EACH LOCATION? (Gas and oil, food, lodging, rental of boat and tackle, bait, etc.)

Yellow Perch	Walleye (Yellow Pike)	Bass	Bluegill/Sunfish	Northern Pike	Muskie	Chain Pickerel	Lake Trout	Rainbow/Steelhead Trout	Brown Trout	Coho or Chinook Salmon	Atlantic/Landlocked Salmon	Brook Trout	Bullheads/Catfish	Other	No Specific Type	TOTAL SPENT AT EACH LOCATION	TOTAL SPENT WHILE TRAVELING TO AND FROM EACH FISHING LOCATION
		5					1								2	$175	$45

About the Value of Your Fishing

The information that you provide on Questions 15-16 will help us develop estimates of economic values of New York's fisheries resources.

To answer Q15, we want you to focus on a particular 1988 fishing trip to the location and waterway that you told us about on Line 2 of the previous question (Q14). (Line 2 has been chosen at random). Refer back to Q14 and note the location that you listed on Line 2. If you took more than 1 trip to that location in 1988, try to focus on 1 specific trip. Now answer Q15.

15. a. Number of days fished on this trip: ____ days.

b. Approximately how much did you spend for YOUR SHARE of the expenses for that trip (gas/oil, food, lodging, rentals, bait, etc.). (Do not include any major items of fishing equipment that you may have purchased):

$________

c. Now suppose the costs of this trip had been substantially higher. This could have been because of a sudden increase in the price of gasoline, food and lodging, or any other expense items. If your total cost for this trip had been 3 times what you actually spent, would you still have taken this fishing trip?

_____YES (Answer Q15d)

_____NO (Skip to Q15e)

d. If the total cost of this trip had been 4 times what you paid, would you still have taken this trip?

_____YES (Skip to Q15f)

_____NO (Skip to Q15f)

e. If the total cost of this trip had been 2 times what you paid, would you still have taken this trip?

_____YES

_____NO

f. What is the MAXIMUM total amount you would have been willing to pay for this fishing trip before you would have decided not to go?

MAXIMUM total cost you would have paid: $_________

Capital Expenses

We would like to estimate the total expenditures of anglers on capital equipment used for fishing that was PURCHASED IN NEW YORK STATE IN 1988. Please list below the purchase price of such items, but only if they were purchased in New York in 1988. Then, for each item, please estimate the percent of its use that is fishing-related.

FISHING-RELATED ITEMS PURCHASED IN 1988	APPROXIMATE PURCHASE PRICE	PERCENT USED FOR FISHING
	(Enter amounts and percents only for items purchased in New York State in 1988)	
16a. Boat or canoe	$________	____%
b. Motor for boat	$________	____%
c. Boat accessories (include downriggers, depth finders, batteries, radios, etc.)	$________	____%
d. Travel or tent trailer	$________	____%
e. Pickup, utility vehicle, camper, or van	$________	____%
f. Motor home	$________	____%
g. Boat trailer/hitch	$________	____%
h. Special all terrain vehicle	$________	____%
i. Cabin/second home	$________	____%
j. Snowmobile	$________	____%
k. Ice chest	$________	____%
l. Rods, reels	$________	100%
m. Tackle box, other tackle	$________	100%
n. Special clothing, boots	$________	____%
o. Other items	$________	____%

CHECK HERE _____ IF YOU DID NOT BUY ANY NEW FISHING-RELATED EQUIPMENT IN NEW YORK IN 1988.

THE FOLLOWING INFORMATION WILL HELP US CATEGORIZE FISHING PARTICIPATION IN NEW YORK AND PREDICT FUTURE INTEREST IN FISHING. ALL INFORMATION IS KEPT STRICTLY CONFIDENTIAL AND IS NEVER ASSOCIATED WITH YOUR NAME.

17. How many years have you been a resident of New York State?

_____ Years

18. Which of the following best describes the area where most of your first 16 years were spent (Check one):

_____ Rural, hamlet, or village (under 5,000 population)

_____ City of 5,000 to 24,999 population

_____ City of 25,000 to 99,999 population

_____ Major city of over 100,000 population

_____ Suburb of major city

19. At what age did you first fish on a fairly regular basis (at least 5 days per year)?

Age when you first started fishing regularly: _____

Check here _____ if you have only fished occasionally in the past

20. In approximately what year did you buy your FIRST New York fishing license?

19____

21. Prior to last year (the October 1, 1987 through September 30, 1988 license year), in which of the previous 3 years do you think you bought a license that permits fishing in New York (check all that apply):

____1986-87 ____1985-86 ____1984-85

22. As of today, have you purchased a license that permits fishing in New York in 1989?

_____Yes

_____No: If not, do you think you will buy a 1988-89 New York license?

_____Yes ____No ____Uncertain

23. Did you go hunting in New York between January 1 and December 31, 1988?

____Yes ____No

24. Are you presently a member of a fish and game club or an organized sportsman's group?

____ YES ____ NO

25. How many years of school did you complete, counting 12 years for high school graduation and 1 year for each additional year of college, technical, or vocational training?

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20	22	24	26	28	30	32	34	36	38	40	45	50	55	
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_____YES _____NO

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